SCIENTIFIC AMERICAN

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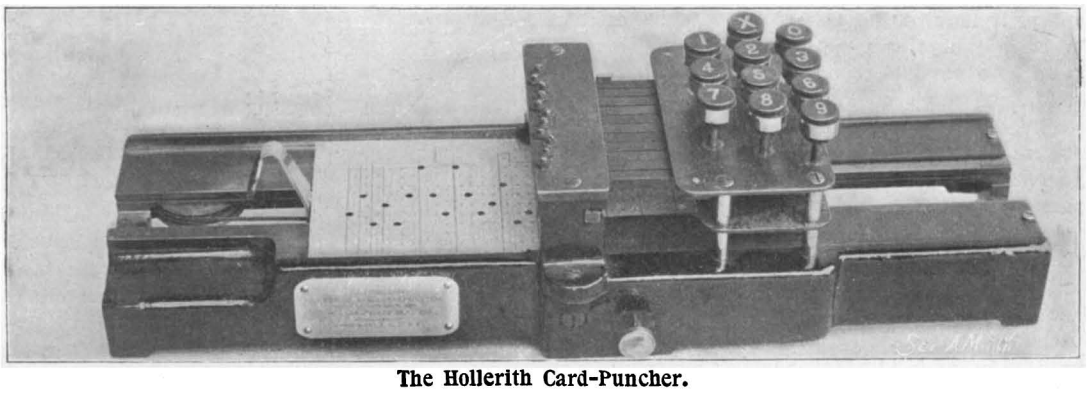
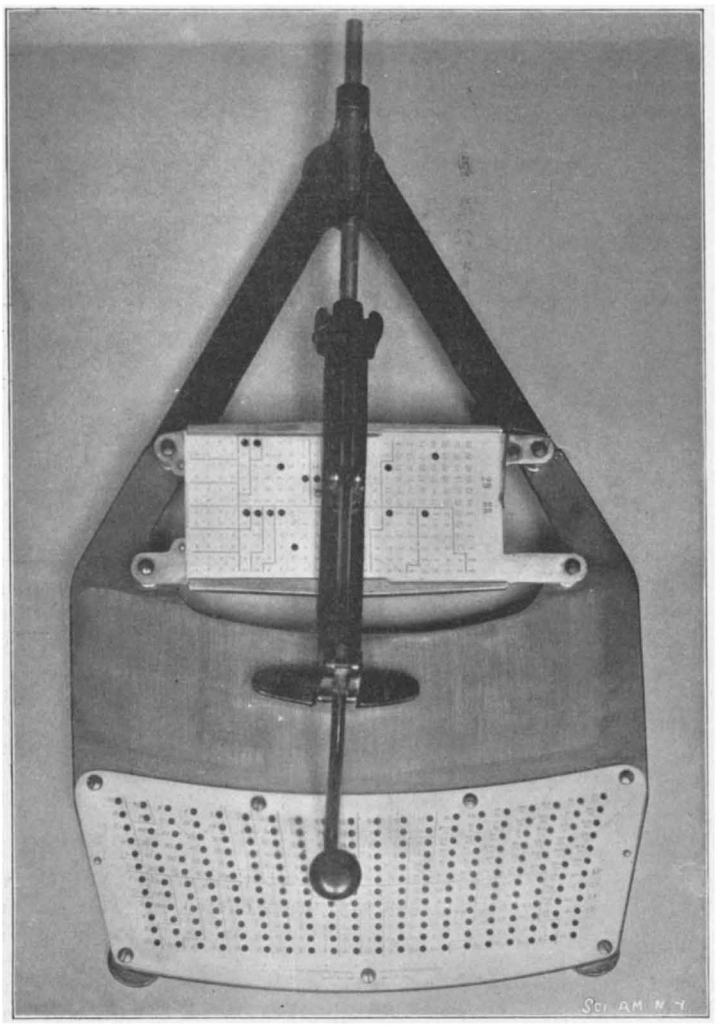
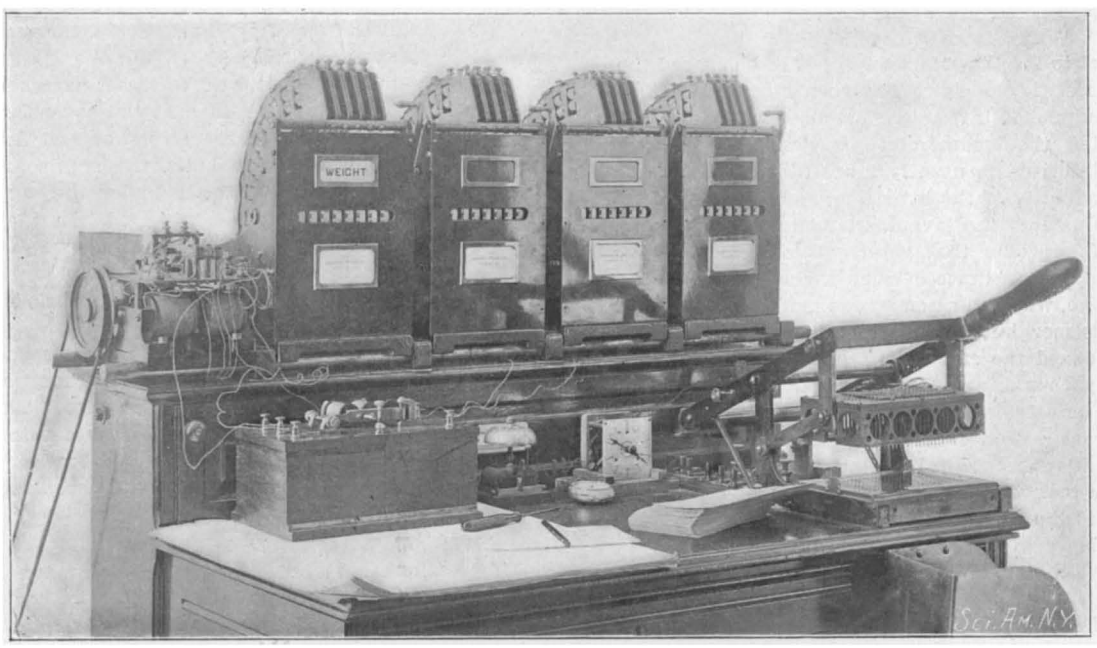


The Hollerith Card-Puncher.

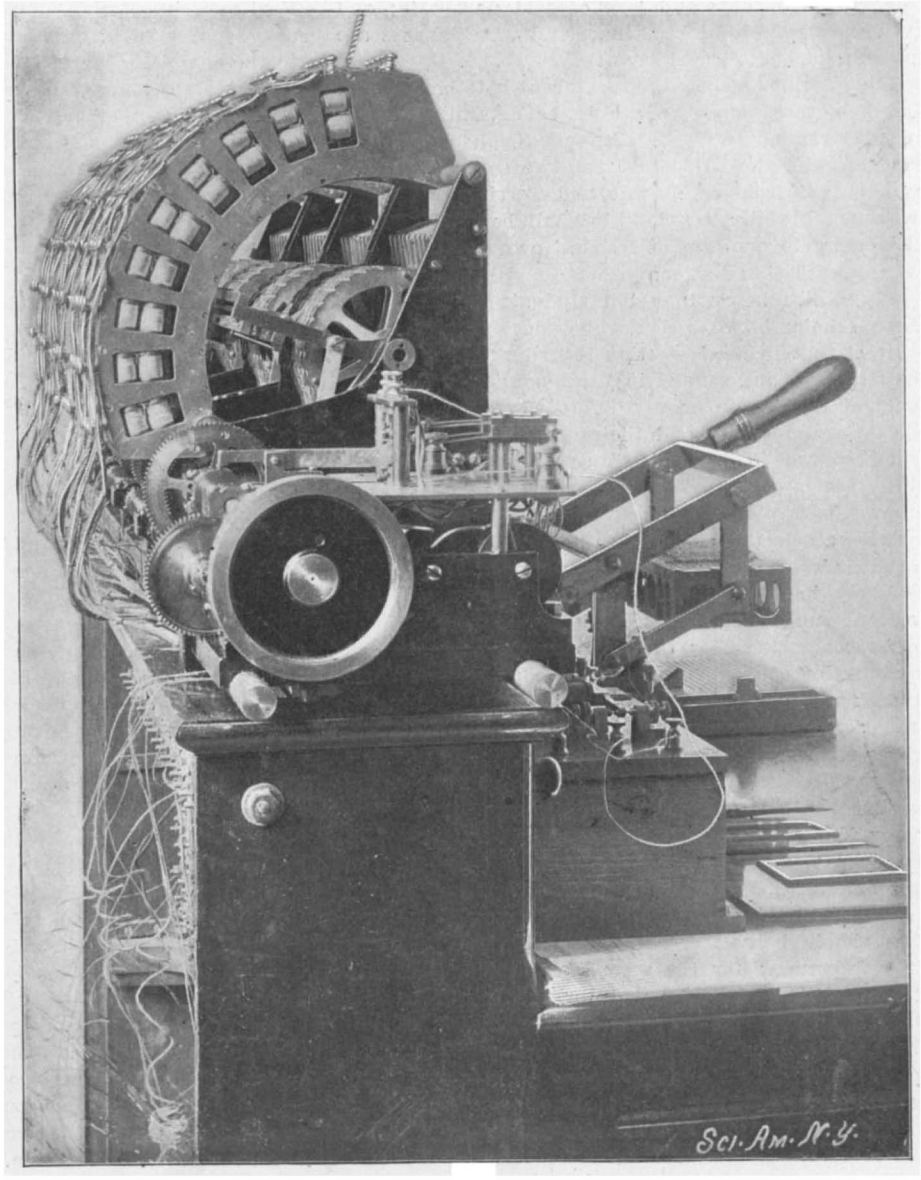


Population-Card Punch.



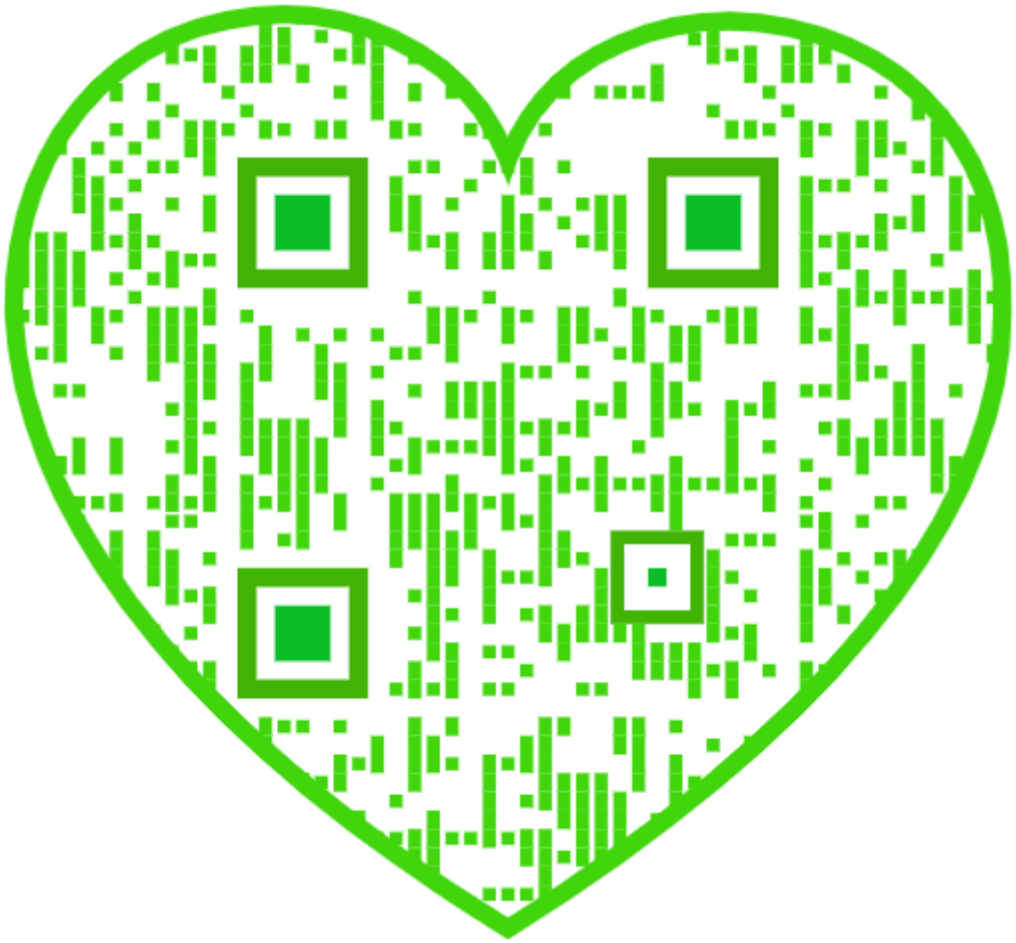
Front of Tabulating and Adding Machine.

Automatic Tabulating-Machine.



Rear of Tabulating and Adding Machine.

CENSUS-TAKING BY MACHINERY.—[See page 275.]



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NEW YORK, SATURDAY, APRIL 19, 1902.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE AMERICAN SCHOLARSHIPS AT OXFORD.

Probably no will made public in years has attracted so much attention as that of the late Cecil Rhodes. It is characteristic of the man that its provisions should be on such a vast scale as to affect the interests of three continents. The feature of the will which is of the greatest interest to Americans is the magnificent provision for the establishment of scholarships in Oxford University for American students. This desire to bring the three great branches of the Anglo-Saxon race into closer unity and understanding appeals to our imagination and fills us with astonishment, even in a country where we are accustomed to having enterprises established on a gigantic basis. We believe that this is almost the first time in the history of the race that an individual, by means of his will, undertakes by a single provision of that will to bring about so many praiseworthy and far-reaching results. The objects he strives for are apparently: First, the binding together of three great peoples in a bond of common brotherhood; second, the establishing and inspiring of high educational standards; and, third, the establishing, as far as possible, of an ideal standard of manhood.

We believe, also, that this is the first time that a scholarship or fellowship has ever been offered in any university in which the standard of attainment was not based upon scholarship alone. In the present instance, however, the incumbent must possess other great qualities besides that of learning. He must be recognized as a man among men. In selecting the incumbent his character is to be taken into consideration; his manliness and love of athletic sports; and even the qualities of kindliness and unselfishness are to be taken into consideration.

The questions of how the incumbent is to be selected, and how these qualities are to be determined upon are only vaguely set forth in the provisions of the will. The terms of the will state that two candidates shall be admitted from each State and Territory and that the amount of the scholarship shall be $1,500. It is interesting to quote Cecil Rhodes' own words in connection with this matter:

"My desire being that the students so elected to those scholarships shall not be merely bookworms, I direct that in their election regard shall be paid to their literary and scholastic attainments and fondness for and success in manly outdoor sports, such as cricket and football, and their qualities of manhood, truth, courage, devotion to duty, sympathy for and protection of the weak, kindliness, unselfishness and fellowship exhibited during their school days, moral force, character and instinct to lead and to take interest in their schoolmates, for these latter attributes will be likely in after life to guide them to esteem and perform public duties as the highest aim.

"As suggestions for the guidance of those having the selection of the scholarships my ideal of a qualified student would combine these four qualifications in the proportions of three-tenths for the first, literary; two-tenths for the second, fondness for sport; three-tenths for the third, the qualities of manhood, and two-tenths for the fourth, exhibition of moral force. According to my ideas, if the maximum number of marks were 200 they would be apportioned, sixty each for the first and third, and forty for the second and fourth qualifications. The marks for the several qualifications should be awarded independently, for the first, by examination; for the second and third, on ballot of their fellow students, and for the fourth on the report of the headmaster of the candidate's school. The awards should be sent for the consideration of the trustees or some person appointed to ascertain by averaging the marks in blocks of twenty the best ideal of a qualified student."

It must be admitted that as we think over these provisions of the will and the rather nebulous manner in which these provisions are set forth, the plan seems almost Quixotic. It seems as if the testator hardly realized the difficulty of trying to determine how in each State or Territory it would be possible to find the most available representatives to receive the scholarship. From what schools or colleges is the incumbent to be selected. In an empire like Germany this problem is not nearly so difficult of solution. It would be a comparatively simple matter, perhaps, for the Kaiser to elect that the applicant should be selected, in the manner provided by the testator, from certain institutions. Of course, such a method of selection is not possible in the United States. It is probable that large discretionary powers have been vested in the executors of the will. If they are familiar with the conditions of our institutions of learning in this country, it is probable that some method of alloting the scholarships can be determined upon. Perhaps it would be possible to appoint a joint international committee which could delegate to certain schools or colleges, according to their geographical situation and their literary standing, the privilege of offering, perhaps, to their first year men an opportunity to present themselves as candidates. It will be very interesting to follow the fate of these provisions. The problem as presented is entirely novel, and in order that the object of the testator may not utterly fail, it requires the most judicious and tactful handling. At all events, it should place before the youth of the land a high ideal of what scholarship in its highest sense should mean.

UNJUST AND UNGENEROUS.

We regret to see that Marconi is not to be spared the ungenerous criticism which has been made against so many distinguished inventors, just as soon as they had demonstrated the commercial practicability of their ideas. This criticism usually takes the form of denying the originality of the invention, and insinuating or openly stating that the inventor is claiming credit and appropriating profits that rightly belong to another. The last notable instance of such a charge occurred a few years ago, when an attempt was made to prove that not to Bessemer but to some obscure Pittsburg iron worker belonged the credit of inventing the converter with its epoch-making effect upon the world's steel and allied industries. The Scientific American took an active part in that controversy, which ended in the universal indorsement of Bessemer's claims; and the position we took then upon the question of credit for inventions is the same that we hold to-day in the matter of the Marconi telegraphy.

We believe that if the profits and honor of an invention are to be claimed by any one man, they belong, not to the inventor of some one detail, however essential it may be, but to the man who by a comprehensive study of the whole problem and by patient practical experimentation, develops the idea from the first crude device, or from many separate unrelated devices, to the complete, practicable apparatus, capable of taking its place among the serviceable appliances of our modern life.

Such an inventor is Marconi, and such an invention is the system of wireless telegraphy which bears, and we venture to think will for all time bear, his name. Clerk Maxwell suggested and Hertz discovered the etheric waves by which the transmission of electrical impulses is rendered possible; Onesti discovered, Branly and Lodge improved, and Marconi perfected a coherer by which these impulses might be picked up and thrown upon a telegraphic receiver; and to Marconi belongs the credit of developing what was merely a curious toy into a wonderfully perfect system, which takes rank with the invention of Morse as one of the greatest in modern times.

The scientific world has always been the more ready to give Marconi full credit for his brilliant work, because of his modesty, and the unvarying candor and fairness with which he has acknowledged his indebtedness to Maxwell, Lodge, Branly and other workers in the field of etheric telegraphy; and hence the recent unseemly attack made upon him by Prof. Sylvanus Thompson in the Saturday Review, so far from shaking the public confidence in Marconi, has merely served to awaken astonishment, that charges so manifestly unfair should emanate from a physicist of such high standing. Thompson is entirely in error when he says that Marconi uses without acknowledgment these devices of Lodge, for he has always, at least during his many visits to this country, been ready to give ample credit to their inventor.

Apart, however, from all question of these acknowledgments, is that of the actually accomplished facts of wireless telegraphy. We do know that messages have been sent over 1,500 miles of water, and that signals have been sent clear across the Atlantic; we do know that only one man has done this, or to-day can do it, and we know furthermore that these epoch-making achievements have been wrought by that one man as the crowning triumph of long years of indefatigable experiment, invention and design. Can Lodge send signals across the Atlantic and messages for 1,500 miles? Can Slaby? We think not, and we also venture to believe that had the practical Marconi never turned his thought and zeal to the problem, Lodge's coherer might to-day have been merely a curious laboratory toy, and Slaby's professional zeal might have been confined to the quiet of the classroom and the lecture hall, and might never have been quickened into commercial activity by the alluring possibilities of etheric telegraphy, as demonstrated by the early successes of the young Italian.

THE AIRSHIP AND THE AEROPLANE.

There is no question that as between the airship and the aeroplane, the latter is the more scientific and mechanically the more attractive type of air locomotive—if we may use the term; although it must be admitted that in the present state of the mechanical arts, a practicable aeroplane as yet exists only upon paper. The airship with its huge, unwieldy, and perishable gas-filled balloon, has nothing to recommend it but the fact that it can float at a predetermined adtitude and does not depend for its ability to remain in mid-air upon the continuous working of its motors. The aeroplane does; and the instant its propellers cease to revolve, its buoyancy is lost. But at what a cost and risk the airship maintains its equilibrium is shown by the numerous disasters that have befallen Santos-Dumont in the various (six in all) airships which he has built. The whole trouble with the gas-supported ship lies in the vast bulk of the balloon, and the great area that it presents to the wind. In any but the most moderate breeze, the craft is more or less unmanageable; and we do not yet know how to build a motor which will be light enough to be carried by the balloon and have at the same time sufficient power to drive it against a strong breeze. And even if such a motor could be built, the frame and fabric of the balloon would collapse under the wind pressure to which it would be subjected. In view of the many and baffling problems presented, we cannot but admire the persistence and pluck of Santos-Dumont, who is to try again—this time on our side of the water.

But why do we not hear from Langley, Maxim and others whose experimental work of the last decade was so extremely interesting and so full of promise? The advances that have been made of late in the development of light, high-powered motors, should materially assist in the development of a successful aeroplane.

MEN OF WEALTH AS INVENTORS.

The impression that the American young man of wealth passes his time simply in seeking his own amusement is very far from being the case, as is evidenced by the number of well-known names which may be found among the list of those who have received letters patent. Narrow as the scope of this list may be, it nevertheless proves that the inventive genius of the American is not confined to the mechanic or the farmer, but that men of wealth do their share in enhancing the industrial development of the country.

Perhaps the most widely-known rich inventor is Cornelius Vanderbilt. Most newspaper readers have learned merely that he is the patentee of a locomotive boiler of some peculiar construction. Exactly what the peculiarity of this construction is, perhaps only the readers of technical papers know. As a matter of fact, the main feature of the invention consists in a firebox made cylindrical in cross section and having its rim corrugated in a transverse direction; the firebox being located eccentrically within a firebox section inclined to the horizontal, to reduce the water space below the firebox line at the back end, the forward end being submerged to a less extent than the rear, to increase the effective heating surface for a rapid generation of steam. So efficient is this improved construction, that the Vanderbilt boiler is used by the principal roads throughout the country. In 1900 six locomotives were built at the Baldwin Works equipped with Vanderbilt boilers; in 1901 twenty-three were in use on various railroads. Mr. Vanderbilt has not stopped with the invention of a firebox. He has also devised a new type of locomotive-tender which is now in practical use; a process of making truck-bolsters, brake-beams, etc.; a draft-gear; a car-truck, and a tank-car which is now widely used. The annual royalties accruing from these various inventions are substantial and must represent a handsome amount.

Col. John Jacob Astor likewise finds time to invent new machinery. Several years ago he patented a pneumatic road-cleaning machine; and only a few weeks ago he received a patent for a novel turbine which is to be used primarily for the propulsion of steamers.

Both Mr. Astor and Mr. Vanderbilt have devoted their attention exclusively to industrial invention. Mr. P. Cooper Hewitt, on the other hand, has branched out in the field of electricity and physics. At a *conversazione* held last year at Columbia University, and at a recent meeting of the American Society of Electrical Engineers, his mercury-vapor lamp was exhibited—the practical culmination of research in a new field in electro-physics. Turning his attention to the

manufacture of glue, with which the name of his inventive and philanthropic grandfather, Peter Cooper, is associated, he devised noteworthy improvements in apparatus and means for glue-making, among which may be mentioned a glue-manipulating machine, a process of purifying glue, a glue-stock cutter and feeder, an evaporator, and a drier. Besides these, the long catalogue of his inventions includes a condenser, a spring-tire, a centrifugal machine, an apparatus for aerating liquids, an apparatus for manufacturing beer, a sheet spacer, and a leaf for flybooks. Mr. Hewitt has for the past few years bent his energies principally to the perfection of the above-mentioned vapor lamp, which bears his name and for which he has taken out a score or more of patents.

Like his brother, Mr. Edward R. Hewitt has also devised improvements in glue-making, among which is a preparation of glue-stock for boiling. In the fields of physics and mechanics he has also come forward as an inventor. Several years ago he patented a new method of printing photographs in color, and recently began a series of researches in those branches of engineering with which the names of Sadi-Carnot and Dr. Maynard are linked.

Still other well-known wealthy inventors are David Wolfe Bishop, Anson P. Stokes, Jr., and Clarence G. Dinsmore. Mr. Bishop, as one might infer from the prominent part that he has taken in the development of automobilism in America, has been concerned chiefly with improving the motor carriage. Mr. Stokes has invented an ingenious apparatus for playing golf indoors. Mr. Dinsmore has patented a tire-removing and replacing device, and has applied for a patent on a pneumatic-tire protector.

Incomplete though this list may be, it serves to indicate a serious purpose on the part of some of our young men of wealth, which is sure to be highly commended.

RECORD OF AMERICAN AUTO SHOWS.

Although it is barely two years ago since the advisability of holding an automobile show was first seriously considered by the few makers then in the field, even the most enthusiastic of the promoters betrayed signs of a lurking suspicion that despite every effort to make the thing popular, it might fall short of expectations.

Nowadays, no sane man would raise the question, for fear of making himself the laughing stock of the trade and the public. It would be difficult to find simpler and more direct evidence of the sweeping progress made by the automobile industry. Large, well-equipped plants have been laid down, numerous minor factories have sprung up all over the country, mechanical repair shops have entered vigorously into the competition, and many manufacturing establishments have added a factory department for automobile building, not to mention the nearly two thousand individual makers of automobile machine parts, fittings and accessories.

Nowhere has this unique and imposing industrial result been better expressed collectively and comprehensively than at the present Chicago Automobile Show. Almost every type of vehicle, every feature or device which serve as improvements, are to be found there. It is, however, rather difficult to trace the stages by which the present development has been reached, for old pattern vehicles are scarce, and show promoters, no matter how hard they may try, have never succeeded so far in making a collective exhibit disclosing the truly representative stages marking the practical progress in automobile building since it became an industry worthy of the name.

The first American auto show of January 1, 1900, was really more of a compromise with the cycle show, in conjunction with which it was held at Madison Square Garden, than anything else. It was ninety-nine per cent "bike" and one per cent "horseless." The automobile was put into the bicycle show as a special feature to attract the public, which it did in a way not foreseen by the cycle makers; for the spectators seemed disposed to ignore the presence of bicycles and prefer gazing at the baker's dozen of automobiles displayed. So that the auto feature accomplished much more than the exhibitors had hoped for, and proved instrumental in breaking the ice for future shows. It was a trial balloon, showing the makers which way the wind was blowing, and it was sent up just in the nick of time.

Immediately there was a renewed interest in automobiling and a corresponding activity among the makers. Chicago, jealous of New York's "horseless" affair, moved into line with an automobile show, which was intended to be a good deal more than it turned out to be. It was held in September, 1900, at the Washington Park, under the auspices of the Chicago Automobile Club. It was an outdoor affair, with plenty of room for track events and exhibitions of every conceivable kind. There were some thirty-odd exhibitors, ensconced behind very creditable-looking stands. It was to be a big treat, but—it rained, the crowds went home, the makers lost courage, the special hill-climbing events and track tests were slovenly and unsatisfactorily conducted by people apparently entirely unfamiliar with such exhibitions, and everything seemed to go wrong. In spite of this setback, the show did some good, and the impression produced by it was by no means lost. Improvements in the vehicles displayed were easily noticed, and there were many indications that the automobile industry and the popular interest in it had taken a forward stride since January.

The question of making the automobile show a permanent institution now came up for vigorous discussion, and in November, 1900, New York city was able to muster at Madison Square Garden an automobile show in which practically all the makers took part. This show was a clean-cut exhibition exclusively devoted to automobiles, and under the efficient management of the Automobile Club of America, it proved a commercial as well as a popular success. All doubts as to the instrumentality of such shows were swept away. The industry was copiously and intelligently represented by motor-vehicle types of a variety of designs and for many purposes; the spectacular feature was signally supplied by a small speeding track on which vehicles in motion were displayed; the public patronage continued large throughout the week; and the commercial result was such as to encourage the exhibitors greatly. The Automobile Club of America at this show made the first attempt on record toward the getting up of a historically instructive feature by a very judiciously-arranged collection of models—curious and significant "stepping stones" in the line of motor vehicle construction.

No sooner did the doors close upon this show than another one, under different management, took place, during the following week, at the Grand Central Palace. This exposition was in reality arranged previously to the Madison Square Garden affair, and the management stuck to its date, even when it was found that it would practically cause a collision between the two shows. The Central Palace exhibit proved to be more of mechanical interest than was anticipated, as a few makers that had not shown at the Garden took an opportunity to display some new things at the Palace. Commercially the show was fairly profitable, but it lacked the popular patronage of its immediate predecessor.

Inspired by the brilliant success of the Garden show in New York city, Boston, Washington and Philadelphia produced automobile shows of their own during the winter of 1900.

Under the auspices of the National Automobile and Sportsman's Exhibition Company, Washington made a very respectable bid for honors in the auto show field. The exhibits were mainly gotten up by the local branch managers, and proved ultimately to be of direct trade benefit to them. The attendance was very good, but the show was mainly of local interest.

In Philadelphia the Automobile Club and the Cycle Board of Trade waged a war of dates for some time, the outcome of which was two mediocre shows in foolish competition, when conditions were favorable for making a national impression by joining hands in the promotion of one single show. The Cycle Board of Trade's show was half cycle and half auto, and the Philadelphia Automobile Club's show had the largest number of exhibits.

The Boston show was given up because the promoters, who, by the way, were none too enthusiastic, failed to secure the patronage of a sufficient number of makers.

During the last week of March, 1901, Chicago again forged to the front with a prodigiously advertised show at the new Coliseum, and again—it rained. But this time the show was indoors, and despite six days of steady downpour, and contrary to all expectations, it turned out to be a commercial success of no mean order. At all the stands sales were constantly reported, and the class of people who paid admittance were obviously mainly divided between those who were mechanically interested and those who wanted to make a careful pick before buying.

The January, 1901, automobile show of New York at Madison Square Garden was held under the management of the Automobile Club of America. This was a "mixed" show, in which the bicycle again fought it out with the automobile, and it did not attract much attention. The practicability of the motor-cycle was fully demonstrated, and the chief interest seemed to center around those self-propelled "silent steeds."

The second annual automobile show was held at the same place and under the same auspices during the first week of December, 1901. This was the most important automobile exposition ever seen in this country. It was in every way a well-arranged, tastefully furnished, elegantly appointed exhibition, showing in a compact, convenient form the immense mechanical progress made in motor-vehicle building from the perfecting of parts and accessories to the modeling of bodies and the structural feature of motors and manipulating devices. Nearly all the important makers were represented; the attendance was very large; and the result decidedly gratifying and extremely flattering to the American automobile industry.

SCIENCE NOTES.

L. Vanino (Berichte) finds that when guncotton is treated with a 20 per cent solution of formaldehyde its sensitiveness to shocks is greatly diminished and almost entirely destroyed. When moistened with formaldehyde solution and dried on the water-bath the guncotton loses its explosive power without suffering decomposition. By removing the deposited paraform by means of boiling water, the original properties of the explosive are restored.

A new source of malarial fever has been discovered by one of the assistants of the Liverpool School of Tropical Medicine now at work on the west coast of Africa. Hitherto this complaint has been attributed to the bite of malarial mosquitoes, but the result of recent investigation proves that there is another parasite which is equally as deadly in the propagation of this malady. The new disease-bearer is said to resemble the insect which causes "fly disease" among horses in South Africa.

The workmen digging the foundations for the enlargement of a religious building in Turin discovered, at the depth of about six meters below the soil, a number of articles of great archæological interest. The most important is a hollow bronze head, life size, and a masterpiece of art, in excellent preservation. The hair, the ears, and the eyes show traces of gilding. It is supposed, from comparison with other heads of the same period, to represent Tiberius. It is hoped that further research may lead to the recovery of other parts of the statue.

Out of the 4,200 species of plants gathered and used for commercial purposes in Europe, 420 have a perfume that is pleasing and enter largely into the manufacture of scents, soaps, and sachets. There are more species of white flowers gathered than any other color—1,124. Of these 187 have an agreeable scent, an extraordinarily large proportion. Next in order come yellow blossoms, with 951, 77 of them being perfumed. Red flowers number 823, of which 84 are scented. The blue flowers are of 594 varieties, 34 of which are perfumed, and the violet blossoms number 308, 13 of which are pleasantly odoriferous.

The expedition which started last year under the auspices of the British Royal Society, to explore the cave fauna of the Malay Peninsula, has accomplished some very interesting biological work, and many geographical observations have been made which prove existing maps of this country to be erroneous. The expedition has crossed the Peninsula from Singgora to Kedah, and has discovered that the high mountain range marked on maps does not exist in that part. About 120 miles north of Penang the mountains are over 6,000 feet high. The chief object of this scientific expedition is to study tropical cave fauna with a view to ascertaining whether it will throw light on the history and evolution of cave-dwelling animals.

Dr. E. Ule contributes to Engler's Jahrbuch (30, Beiblatt) some interesting observations on "ant-gardens" in the Amazon region, where they abound on a large number of woody plants. They are generally spherical in form and about the size of a walnut. They are formed by several species of ant, which appear to collect the seeds of many different plants and to sow them in these nests, covering up the seedlings with humus when they begin to germinate. In the structure of these "ant epiphytes" the foliage and the roots display characters which especially adapt them for the situation in which they grow, and promote also the protection of the ants themselves in their nest. Quite a number of the epiphytes were found by Ule as denizens of the ant-gardens and nowhere else. Among them were three species of Piperaceæ, five of Bromeliaceæ, five of Gesneraceæ, one of Moraceæ and one of Cactaceæ.

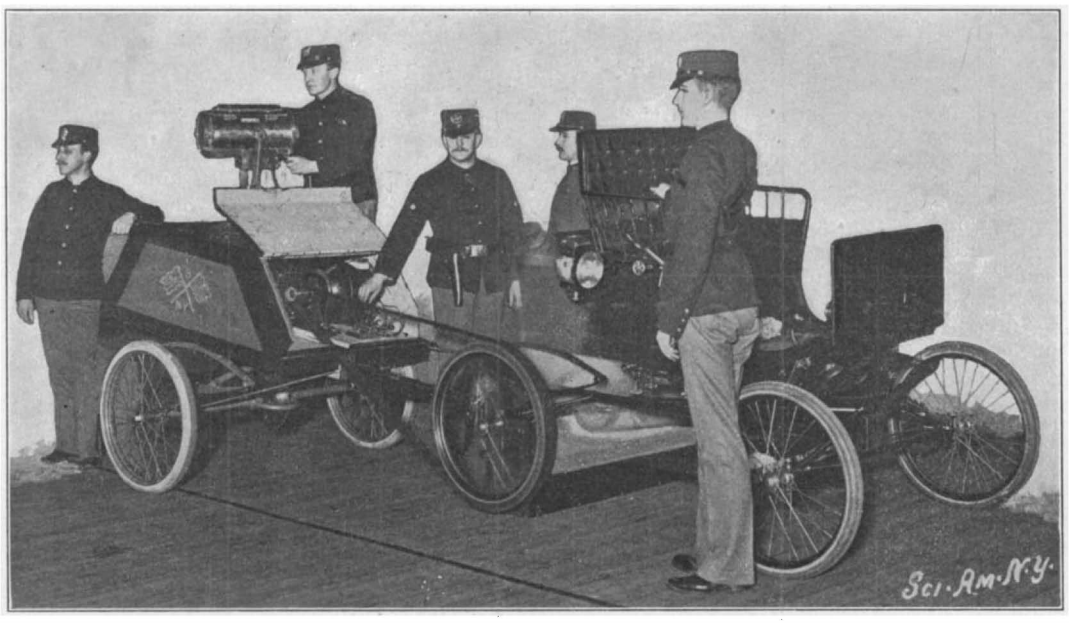
The extraordinary dust fall in Europe a year ago (March 9-12, 1901) has been studied by Hellmann and Meinardus, whose memoir has lately appeared in the Abhandlungen of the Royal Prussian Meteorological Institute. It is shown beyond dispute that the dust came from the Sahara, and not from South America, as the famous Ehrenberg concluded for similar dust-falls many years ago. Dust storms were observed in the Algerian Sahara during the days immediately preceding the dust fall in Europe. South of the Alps there was a stormy sirocco; further north, the lower air was relatively quiet, but the higher currents were strong from the south, their velocity of seventy kilometers an hour agreeing with the rate at which the dusty area was extended northward. The microscopic analysis of the dust showed it to be a mineral composition such as the Sahara could furnish. Around the the Mediterranean the dust fell during the dry sirocco, but further north, especially in northern Germany, the dust came down with rain and snow. Most of it fell south of the Alps. Further north the size and the specific gravity of the particles were reduced. The average weight of a grain of quartz dust in northern Germany was 1-3,200,000,000 gramme. The total fall is estimated to have weighed 2,000,000 tons.

ELECTRIC SEARCHLIGHT FOR FIELD SERVICE.

The Second Signal Corps of the New York National Guard have hit on a very simple, and at the same time a most efficient method of operating an electric searchlight in the field. As shown in the engraving, a locomobile is employed both for transportation and for producing the power to run an electric generator, which is situated in the trailer attached to the rear axle. When it is desired to use the searchlight, the rear wheels of the locomobile are jacked up by tilting a supporting block against the rear axle and pushing the vehicle back onto it, thus raising the rear wheels about two inches off the ground. The tongue of the trailer is now secured to the right end of the block, and a brace rod attaches the body of the trailer to the left end, thus insuring a rigid connection and a perfect alinement of the generator pulley and the driving wheel. The trailer contains a 1-kilowatt generator of the Sprague make. This is provided with a 3½-inch pulley, which is driven by a belt from the right rear wheel of the locomobile. Of course, it is necessary to couple together the differential gear on the rear axle, otherwise the driving wheel would remain stationary while the other would spin around. The coupling is easily made, for the locomobile is of an early type, in which the differential gear is not incased. Bolt holes are provided in the large bevel gears, through which bolts are inserted to clamp together the rear axle sections into an integral driving shaft, one wheel serving as a balance wheel for the other which drives the generator pulley. Power is thus generated to run a 50-volt, 10-ampere lamp. A marine projector of the Bogue make is used, having a 7-inch Mangin mirror and projecting a beam of 8,000 candle power. The current generated can also be used in working the Ardois system of signals. It takes an incredibly short time to rig up the machine for action. Four men are employed to handle the apparatus, two of them being seated on the trailer while the machine is on the road. The trailer, aside from containing the dynamo and searchlight, has a large chest at the rear in which emergency tools of all descriptions are carried.

The trailer is a "home-made" device, being designed by the captain of the Corps and constructed by the men in their armory, from the materials they could get together. This is shown from the fact that it is mounted on the rear truck of a locomobile, which contains a differential gear, serving no purpose, of course, in this place. This, however, does not detract from the ingenuity of the Corps, but rather accentuates their resourcefulness in using the things at their ready command.

The possibilities of the apparatus were well brought out at the Military Tournament recently held in Madison Square Garden, New York. A tower was hastily constructed of timber lashed together with rope, and the projector was mounted on the top. Wire connection was made with the generator, and the searchlight was very advantageously used from this elevated position.



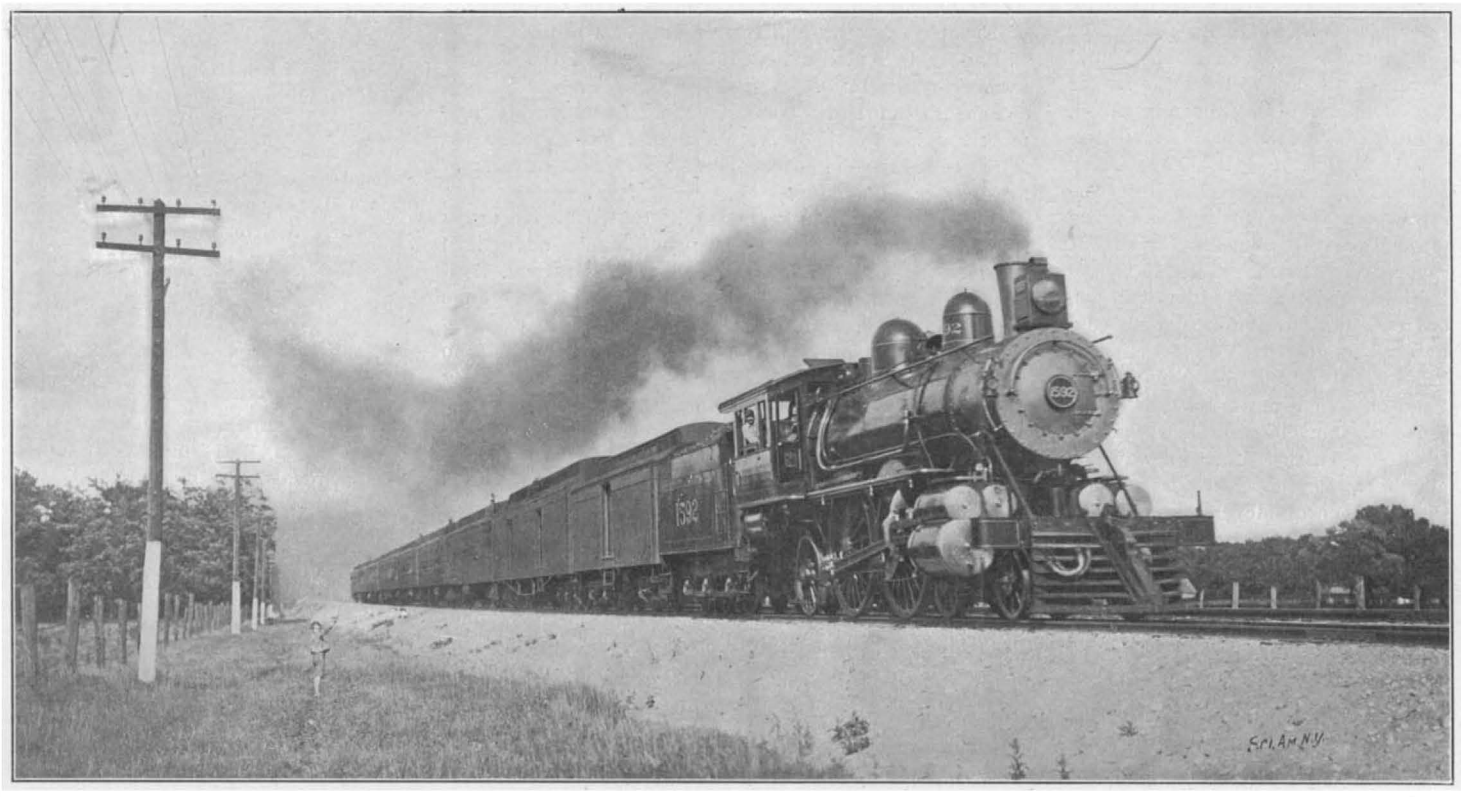
ELECTRIC SEARCHLIGHT FOR FIELD SERVICE.

The newest form of sound records for phonographs is a sphere. It is claimed that a spherical record besides being compact, is capable of recording a speech or song of considerable length.

RAILROAD TRAIN TAKING ITS OWN PHOTOGRAPH.

A passenger train on the Chicago, Burlington & Quincy Railroad recently performed the rather remarkable feat of taking its own photograph, as reproduced in the accompanying illustration. The electric current was employed to secure the picture in an ingenious manner. The camera was equipped with a very rapid shutter, estimated to move at a speed of 1-1,000 of a second in covering and exposing the lens. One of the rails over which the train was to pass was connected with the camera by an electric switch which operated the cylinder, furnishing the compressed air to move the shutter. The photographer who essayed to get the picture calculated that when the train was running at full speed it would pass over about eighty-eight feet in one second, and made arrangements accordingly. The electric switch was placed in position about six feet back of the place where it was desired to catch the photograph, in order to allow for the movement of the electric current and release of the shutter, rapid as it was. With the electrical device completed, the camera was set up and focused at the portion of the track to be covered, and the shutter set for instantaneous exposure and connected with the switch. When the front wheels of the locomotive drawing the train touched the electrically connected rail, the shutter was released and an excellent picture taken, not even a blur showing on the negative after development. This automatic photograph was planned by Mr. Ayrault Green, of Chicago, and taken in the suburbs of the city.

An experiment is now being made by the Chicago & Northwestern Railroad on the new Overland express which will be watched with much interest both by railroad men and the public at large. The express in question is equipped with telephones, which connect not only the several cars, but can be connected with local and long distance wires at any station along the line. If this experiment proves successful the company will probably install a service, which will enable passengers to telephone from a moving train.



INSTANTANEOUS PHOTOGRAPH OF AN EXPRESS TRAIN, TAKEN BY ITSELF WHEN RUNNING AT FULL SPEED.

Popular Errors in Meteorology.

Prof. Gannett, of the United States Geological Survey, has a paper in the Bulletin of the American Geographical Society which treats of popular errors in meteorology and geography, entitled "Certain Persistent Errors in Geography." A few of his points are summarized in what follows:

Forests and Rainfall: An example of the persistence of error is the idea that the presence or absence of forests has an influence on the amount of rainfall. Some keen observer long ago detected the fact that forested regions enjoyed a heavier rainfall than those not forested, and jumped to the conclusion that rainfall was produced by forests, and that the removal of forests diminished the rainfall. Looking over the earth he found many treeless desert regions and forthwith instanced them as frightful examples of men's wastefulness. Syria, northern Africa, parts of Italy, are often quoted as illustrations of man's destruction of climate. In reply, man can certainly plead not guilty. The geography of this Mediterranean region, the configuration of land and water, and the direction of the prevailing winds, are such as to give it a light rainfall—forests or no forests. The situation is really this: Want of rain prevents the growth of trees; want of trees does not prevent rain. Forests and Floods: Another persistent error is the belief that floods in our rivers are more frequent than formerly because of the cutting down of forests in their drainage basins. It is probable that the clearing of land by cutting away forests and undergrowth does change the regimen of streams, increasing their flood height and diminishing the flow at low stages. In other words, water probably runs off or evaporates more rapidly from bare ground than from ground covered with forests. But where the forests are cut away the ground is seldom left bare; it is cultivated or quickly becomes covered with bushes which hold the water quite as effectively as forests. The main fact is, however, that the floods in our rivers are no greater or more frequent now than in the past.

Climates and Ocean Currents: The well-known mild climate of the northwest coast of America is commonly attributed to the Japan Current. The Gulf Stream is supposed to have the same influence on the western coasts of Europe, etc. But can it be supposed that the Japan Current, however warm it may be when it leaves the tropics, retains any appreciable excess of heat after a journey of 6,000 miles in northern latitudes? As a matter of fact, no trace of this current reaches the shores of North America. In the North Atlantic the condition is much the same. The Gulf Stream disappears as a current long before the British Isles are reached.

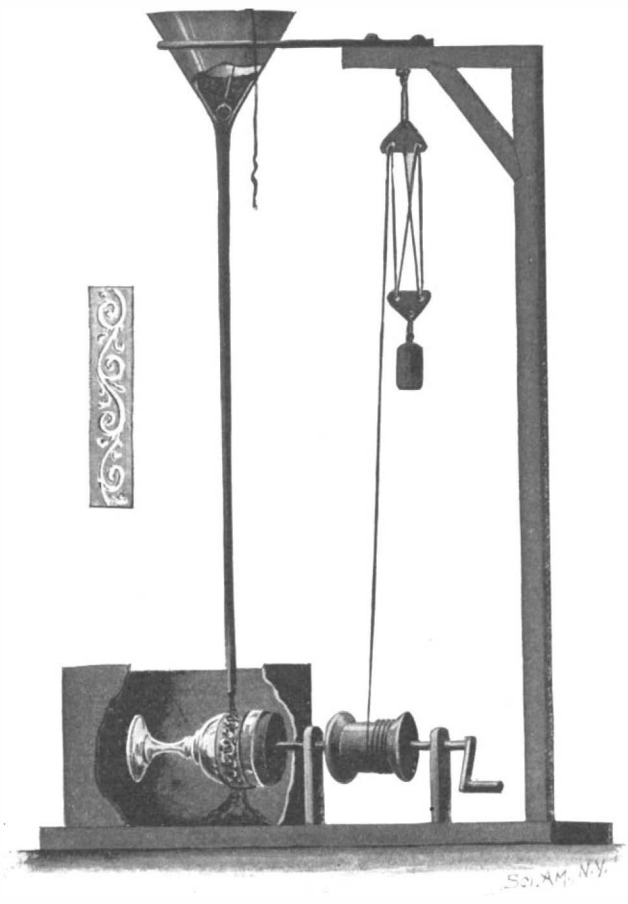
The recent violent earthquake at Shemakha near Baku (Russia) afforded some very interesting and conclusive data regarding the rate of the earth's vibration. Shemakha is some 1,400 miles distant from Moscow as the bird flies, but the seismographic instruments in the university of the latter city duly recorded the disturbance. The earthquake occurred at 12:15 Shemakha local time, and it was recorded in Moscow at 12:13 local time. The difference in time between the two cities is 35 minutes, so the vibration of the earth's crust traveled over the 1,400 miles separating the two points at a velocity of 40 miles a minute.

HOME-MADE DEVICE FOR DECORATING GLASS.

One of the SCIENTIFIC AMERICAN staff has devised a very simple and inexpensive apparatus for cutting initials, monograms and ornamental borders or bands on glass articles, such as tumblers, bottles, hand mirrors, etc., with emery powder.

When a letter or the like is to be cut in the glass, the glass may be held stationary by any suitable means and then all that is necessary is about three pounds of medium-grade emery and a funnel having a tube from four to five feet long and one-fourth of an inch in diameter. The initial is cut through a paper stencil, which is fastened to the glass with mucilage, or held in place by rubber bands. The emery, falling through the tube and striking on the exposed glass, will cut it quite rapidly, and three or four runnings of the emery will form the cut sufficiently deep. It may be stated that the stencil should be a trifle larger than the desired cut in the glass.

To cut an ornamental band on a goblet, tumbler or bottle, the work should be rotated slowly about two inches below the funnel tube. The turning, of course, may be done by hand; but this will be somewhat tiresome, and thus tend to lessen one's interest in the work. A boy with a little skill can rig up an old clockwork to do the turning, or the device illustrated here may be constructed from material found about the house. It consists of a suitably-mounted spindle, having a block of wood or a large cork on one end to fit snugly in the tumbler so as to support it, and also secured on the spindle is a drum, conveniently a large spool, from which a cord extends to connection with a fixed double pulley and a movable double pulley to which the actuating weight is attached. If it is not convenient to procure pulleys, plates of metal, or even of wood, may be pierced with holes, through which the cord may pass, as shown in the cut; but, obviously, pulleys are preferable because of the smaller friction and wear on the cord, which last may be a small fish line. When it is desired to inspect the progress of the work, the flow of emery may be cut off by a small cork attached to a string. When the string is loosened the weight of the emery will force the cork into the upper end of the funnel tube. The spindle should be provided with a crank for convenience in rewinding the cord, and during the rewinding the work of the emery may continue.



GRAVITY METHOD OF ENGRAVING GLASS WITH SAND.

A NEW VARIABLE SPEED TRANSMISSION.

The special device which accomplishes the changes of speed plays a very important part in mechanics in general and particularly in a gasoline automobile. All the ingenuity of the various constructors has not as yet resulted in the complete and definite solution of the problem of a transmission where the modifications of speed are progressive, silent, and without shock. The necessity for an arrangement of this kind in a gasoline carriage results from the nature of the motor itself, which will operate satisfactorily only under certain conditions and within certain limits of speed and power. For instance, if the shaft of the motor be connected by an invariable transmission device to the driving axle of the carriage, and a proper speed reduction to run the vehicle on the level is used, the increased resistance to traction on a grade would stall the motor. It would be incapable of adapting itself to the changed conditions and would simply refuse to work. Notwithstanding the many inventions which this problem has called forth, it is still generally solved in most instances by putting under the control of the operator three or four different speeds. He passes from one to the other with sudden jerks and a disagreeable racket which tell well enough to what harmful shocks the mechanism must be submitted. Certain constructors just as often connect the two shafts through trains of gears, when they wish to obtain different speeds. This arrangement is difficult to operate, noisy, and heavy, while in order to modify certain of its defects as well as to avoid breaking off the teeth of the gears, friction clutches are often added, which increase the weight, size, and price of the apparatus. Other manufacturers have recourse to belt transmission, which is assuredly more pliable and quiet. But here again it is necessary to employ numerous pulleys and belts in order to obtain the different speeds. Parallel cones set inversely with a belt capable of being slid on them laterally, and thus of producing all possible speed variations, have also been thoroughly tried, but the adherence of a belt on a conical surface is always more or less defective. Numerous and eminent inventors, including such men as Edison, have attempted to find a practical solution of this problem. "As long as it applies to the transmission of small powers only," says M. Hirsch, "the problem is relatively easy." Among other devices attention should be called to the transmission by means of rollers that can be moved to variable distances from the center of a flat disk or from the point of a rotating cone. This principle has been used in numerous different forms, one of the most remarkable of which is that of the American constructor Sellers. Mention should also be made of MM. Bataille & Bloom's expansible pulleys, on which the round or V-shaped cord or belt runs on the circle of intersection of the sides of the pulley, which is varied in diameter by moving the sides together or apart. Analogous transmissions have been devised by Richard Simms, Gordon, Reeves, and others. These systems are inadequate for the transmission of any large amount of power, and when comparatively large powers are to be transmitted it is necessary to employ a wide flat belt running on a pulley adapted to it. The problem has therefore remained unsolved up to the present. Now, however, we are happy to state that the new form of pulley devised by M. Roger de Montais has at last furnished the ingenious and complete solution which has long been awaited.

The question may be asked as to what is necessary for the complete solving of this problem. The essential feature is that the two connected pulleys, which form the transmission at normal speed, be able to gradually change in diameter while the apparatus is in full operation, one contracting and the other expanding without the belt's slackening. This is precisely what occurs with M. de Montais' pulleys. The arrangement consists of two expansible pulleys with cylindrical rims which carry a wide, flat belt; and suitable levers for varying the same. The rim of each of the pulleys is made up of sections, and each section is supported by two rods forming a V and pivoted to the section at the apex of the latter. The center of each of the rods forming the V is connected by a short rod to a central holder fast on the shaft between the legs of the V, the whole forming a lozenge-shaped frame, as will be seen by a glance at Fig. 2. As these supporting frames are all equal, they expand and contract together. They are made of light rods cut from sheet steel, which, being somewhat elastic, will give a little.

The middle of the pulley is in three parts. The center part, as just stated, is fast on the shaft, while the two side holders slide along it, thus bringing together or forcing apart the ends of the V-shaped supporting arms, which results in expanding or contracting the pulley. When the latter is contracted to the fullest extent, all the sections of the rim are close together, thus forming one continuous surface. The sections are connected by a circular lazy tongs which serves to brace them. The pulley is driven by the central part or the hub, which is fast on the shaft and which transmits its movement of rotation through the pairs of small steel arms connected to it and to the V of every segment of the rim.

The transmission is composed, as has already been shown, of two expansible pulleys connected by an endless belt, the tension of which tends to contract the pulleys and force aside the movable hubs. The inventor counteracts this tendency by means of springs coiled around the shaft and pressing inward the movable hubs. The springs bear against rings mounted on the shaft, and in such a manner as not to cause any undue friction. The pressure of these springs diminishes as they lengthen, but at the same time the diameter of the pulley increases as well as the opening of the V formed by the jointed supporting arms. The result is that, if the power and flexibility have been correctly calculated, the belt is always held quite taut. Protection is had, therefore, from accidental slipping of the belt, which is often so disastrous and difficult to evade in all ordinary belt transmissions. In fact, the antagonistic effort of the springs takes up automatically any shrinkage or stretching of the belt that may occur in service without, however, producing anything more than a very slight variation in the diameter of the pulleys.

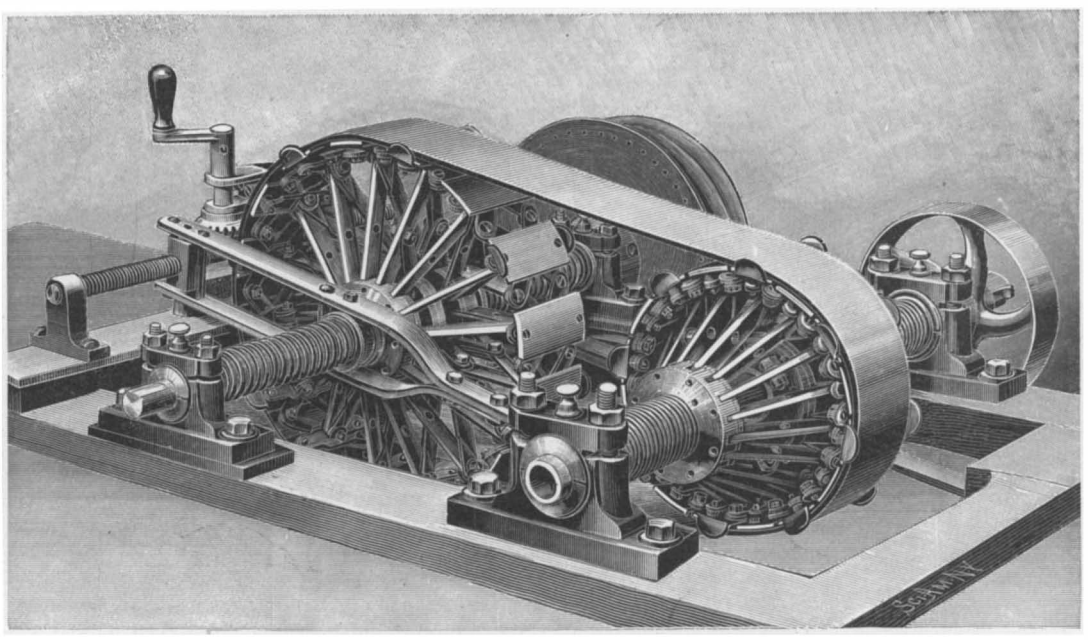


Fig. 1.—GENERAL VIEW OF THE ROGER DE MONTAIS TRANSMISSION.

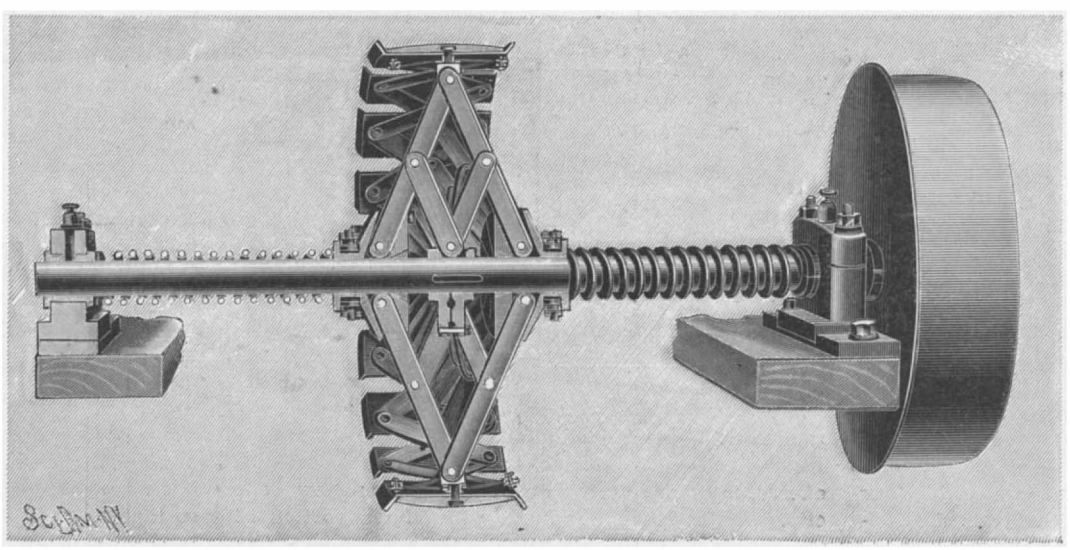


Fig. 2.--DETAILS OF THE TRANSMISSION.

Thus the two great disadvantages of belts—slipping and excess of tension—are done away with at a single stroke.

Another advantage of the apparatus is that it is only necessary to govern one pulley in order to obtain the different speed variations. If the diameter of this pulley is changed, by suitable mechanical means, since the belt is always of the same length, it necessarily produces the inverse modification of the other pulley up to the point where equilibrium is re-established between the tension of the belt for which the apparatus is set and the pressure of the springs.

The mechanism that causes the pulley to contract or expand consists of two levers—one on each side—fastened at one end to fixed pivots and having their centers attached to the movable ends of the hub. The other ends of the levers have holes suitably threaded to travel on endless screws which are cut on either end of the same transverse rod, one left-handed and the other right-handed. This shaft is revolved by turning the handle shown, to which it is connected by bevel gears; and since it is threaded in the inverse direction on its two halves, the two rods are forced apart or together, according to the direction in which the handle is turned, thus contracting or expanding the pulley. The transmission is thrown in or out of gear by a special lever acting on the other pulley and tending to contract it without affecting its mate, thus making the belt loose and allowing it to slip. This lever is not shown in the illustrations, but it engages the throat of one of the outside hubs in a ball thrust bearing.

The view of the transmission that we show was made from one which was given a series of rigorous tests at the end of which a very eulogistic report was made to the Society for the Encouragement of National Industry by the late M. Hirsch, professor of mechanics at the Conservatory of Arts and Trades. This apparatus furnished easily—without any slipping of the belt—all desirable speeds, at several different powers. The transmission was easy and silent; and rapid changes, when under full load, from the highest to the lowest speed and *vice versa*, were obtained with perfect control. A recent application of it to an automobile gave the most satisfactory results. This vehicle, which was exhibited at the Automobile Show, has at this writing been in operation several weeks without a breakdown or hitch of any sort.

That the apparatus is partially automatic in operation, renders it particularly useful in connection with lathes, drills, calenders, and many other machine tools which require transmissions without shock and noise. It is applicable, moreover, to the most diverse powers—to 400 horse power as easily as to 10. Because of its adaptability to such widely varying ranges of power and to so many different fields of usefulness, we thought it of sufficient interest to be made known.

For the above description we are indebted to La Nature.

Wireless Telegraphy Rivalry.

Almost daily the press of England and United States publishes an utterance that comes either from Marconi or Slaby. Marconi maintains that his German rival simply copied his method. The German professor indignantly denies it. But Marconi and Slaby are not the only figures in this little wireless telegraphy war. Dr. Braun, who is also an inventor of an ethereal telegraphic system, insists hotly, at regular intervals, that he is the man to whom the success of space communication is due. Siemens & Halske, who manufacture his apparatus, evidently believe so too, for they have brought an action against the Allgemeine Electricitaets-Gesellschaft, the owners of the Slaby-Arco patents, and will also institute proceedings against the English Marconi Company. Up to the present time this little opera bouffe war has found its expression chiefly in a refusal of the rival companies to receive one another's messages when sent from stations or ships. Now it seems that the daily press is called upon to take up the matter, and then the courts will follow. If the strife is not soon settled, we may have a duplication of the long controversy that followed the introduction of the telephone.

According to the Centralblatt für Accumulatoren- und Elementenkunde, a German company is building electric tugboats with some success, these boats being employed for touring purposes regularly between Zehndenick and Berlin. The boats are 14 to 15 meters in length, 3.25 meters in width, and have a draught of 1.05 meters, and are able to tow barges of 150 tons at a higher rate than the steam tugs usually employed for this purpose. The chief advantage offered by these electrically propelled tugs is that their displacement is considerably less than that of steam tugs of equivalent drawing power, and they are, therefore, peculiarly suited for towing purposes in shallow and winding canals or rivers. The transport of goods by water is said to require only one-fifth of the drawing power required for transport by rail, so that this development of electrically-propelled tugboats is worthy of attention.

Electrical Notes.

That the Marconi system is apparently on the road to commercial success, would seem to be indicated by the formation of a huge company for the purpose of exploiting the invention. The Marconi Wireless Telegraphy Company of America, according to Marconi, was recently founded and capitalized at $6,150,000.

Marconi has finally decided on Table Head, 15 miles from Sydney, as the location for his Cape Breton station. He told the officials of the town that flashes from the trolley wire would interfere with his system, and asked if the town could not take some action in the matter. Forthwith a meeting of the Council was called. A resolution was passed that for a period of five years no trolley line was to be operated within a third of a mile of the station. Marconi says that the work of building the station will begin at once and will be completed within three months.

It is announced that the Marconi Wireless Telegraphy Company have undertaken to install the Marconi apparatus at certain places in the Congo Free State. The district particularly in view at the present time is that around the Upper Congo River, and the first installations will be made at Banana, the post of the north side of the Congo estuary and St. Paul de Loanda, in Portuguese West Africa. It is intended later to connect up Boma, the capital of the Congo State, with Banana in the same way. The apparatus for the first two places mentioned is now on its way to Congo Free State on board the Belgian liner "Albertville." It is said that the intended exploitation of wireless telegraphy in this part of Africa is the result of the success achieved in the experiments which have been going on between Frinton (near Walton-on-the-Naze), in Essex, and Withernsea with the Marconi system. The distance between these two stations is 158 miles, 85 over land and 73 over sea. Banana and St. Paul de Loanda in Africa are two similarly separated points, and are, therefore, expected to give equally satisfactory results with wireless communication.

George Westinghouse has stirred up what may prove to be a hornets' nest in pointing out certain dangers which, in his opinion, should be guarded against in the fitting of trains with electrical apparatus. Mr. Westinghouse says: "It is not very apparent how these dangers can be guarded against. A lifelong experience, however, in connection with safety appliances upon railroads has caused me to view the subject from quite a different standpoint from that usually taken, especially by inventors and promoters, and in some cases by manufacturers of electrical apparatus, who evidently dislike to emphasize the dangers attending the application of so much electrical machinery beneath the ordinary combustible cars now generally in use and the utilization of which has been contemplated in order to keep down the total cost of installation.

"I believe a further useful purpose will be served by particularizing some of the dangers to be guarded against in the fitting of trains with electrical apparatus:

"1. A great advantage of electric traction is the possibility of a much higher speed. This, however, while not extending the vision of the engineer in charge of the apparatus, will require a greater distance within which to stop the train.

"2. When many tons of electrical apparatus are distributed beneath several cars of a train, and of necessity more or less loosely supported, and between which and the rails and roadbed there is but a small clearance, it is evident that much greater precautions will have to be taken than is ordinarily the case with the running gear of the present steam cars, derangements in which have often been the cause of accident.

"3. Electrical apparatus supported beneath the car can develop, by means of a short circuit, heat energy sufficient to instantly ignite cars of wood construction, and this has occurred repeatedly, notwithstanding the presence of safety appliances, intended to guard against such occurrences.

"4. When a total wreck results from an accident, and experience has shown that accidents are inevitable, whatever the mode of propulsion, the débris scattered over the 'live' and other rails would render useless the ordinary circuit-controlling devices which may be located upon the cars. This emphasizes the importance of a non-combustible construction of cars."

Santos Dumont Arrives in America.

The steamship "Deutschland" brought with her on April 10 Alberto Santos-Dumont, who comes to America for the purpose of winning the large prize at the St. Louis Fair. After the St. Louis airship trials he will return to Europe for the purpose of competing for the Pearson prize in England. In July or August he will again come to this country, if a suitable prize be offered, in order to test a dirigible airship in New York city. Santos-Dumont brought with him a portion of the machinery of his new airship, the seventh which he has designed.

Automobile News.

Signor Zanardelli, the Italian Prime Minister, has issued orders prohibiting the Nice-Abazzia automobile race on Italian territory. French automobilists have held an indignation meeting in Turin. The race is definitely declared off.

The French Minister of the Navy has recently made tests of some gasoline launches for light artillery at the port of Lorient. Propelled by an Abeille motor, these boats have given excellent results, thanks to the auto-incandescent igniter, which does away with all danger of fire. Electric ignition was given up for this purpose, since the batteries had such a short life they could not be depended upon.

Mr. Frederick R. Simms has invented an armored automobile for war purposes, that is just now attracting considerable attention at Crystal Palace, London. Although specially designed for coast defense, the vehicle is said to be suitable for offensive work as well. Such is its power that it can drag guns into position and haul stores and men. The motor is of 16 horse power. The speed of the vehicle is 9 miles per hour. A carrying capacity of 12 tons is claimed. Fuel for 200 miles is carried in a tank. The armor of this curious fort on wheels consists of two automatic, quick-firing Maxims, and several thousand rounds of ammunition. A rope ladder and searchlights form part of the equipment.

The German War Office has offered three prizes of 10,000, 5,000 and 2,500 marks respectively for the best motor vehicles for military use. The machines must be ready for testing by February, 1903. Each automobile must be driven by alcohol; must be chiefly adapted for the transportation of military supplies and artillery; must not weigh less than 8 tons; and must have a tractive power of 16 tons on good roads. The vehicle must be able to travel on soft or rough ground and also through water 18 inches deep. A limit of 20 inches has been placed upon the width of the tires. Unfortunately the competition is open only to automobile makers of Germany; otherwise our own manufacturers might have a chance to show what they can do in the way of building alcohol machines.

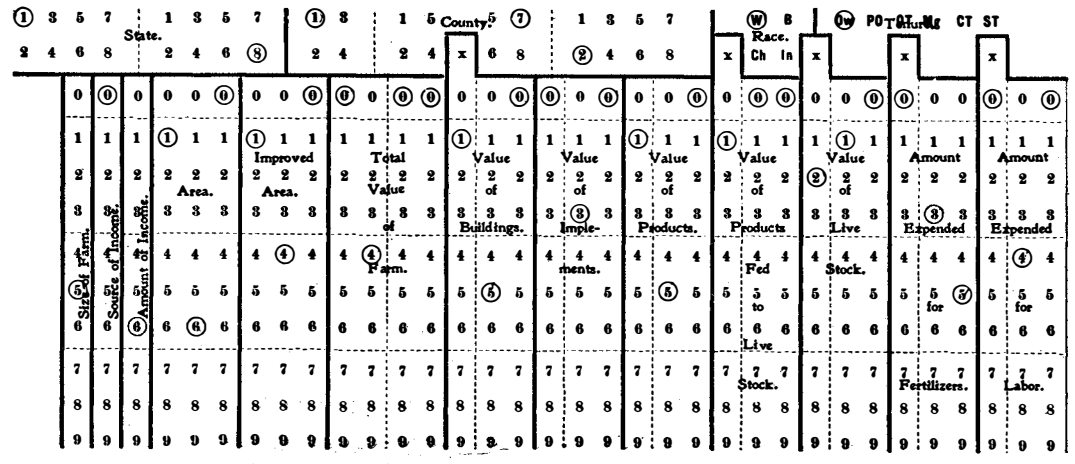
An electric automobile ambulance was one of the features of an exposition which was lately held at Frankfort, in which life-saving and accident appliances were exhibited. The ambulance is very well arranged, and the stretcher carrying the wounded person may be placed inside and the vehicle closed. The city of Hanover has purchased this vehicle. The ambulance is arranged to open at the side and the stretcher is thus introduced: A pair of large doors open to the top and bottom; the lower door takes a horizontal position and is provided with rails by which the stretcher may be slid easily into the interior. The hollow portion of the inside is finished in polished wood so as to be easily disinfected. There is space in the interior for two assistants. The batteries are placed partly under the conductor's seat in front and partly in a box which rests on the rear axle. Two motors are used, and these drive the rear wheels by chain gearing. The motor and transmission devices are quite independent of the body of the ambulance, and are mounted on a specially designed truck in order to avoid all shocks or noise. The vehicle makes an average speed of 10 miles an hour. The battery weighs 1,300 pounds for a run of 20 miles without recharging.

Automobile clubs are now established all over the United Kingdom, mostly in affiliation with the Central Automobile Club of Great Britain and Ireland, which is now agitating for the removal of the restrictions placed on motor vehicles by the act of 1896, which removed earlier absurd regulations, such as that no mechanical vehicle should proceed along the public road at a speed of more than four miles an hour, and that each one must be preceded by a man with a red flag. Electrical World and Engineer says that in a long letter addressed to the press and signed by the presidents of the councils of the French, Swiss, Belgian and Austrian automobile clubs, and also by all the chief British automobilists, cogent reasons are put forward for an amendment of the act which prevents an automobile being worked at a speed of more than 12 miles an hour, even on a straight road free from traffic. The protest points out that the systematic prosecutions and heavy fines imposed for constant breaches of this law are damaging an industry whose importance can be inferred from the fact that in October last, probably the quietest month in the year, $227,205 left the country for France, Germany and the United States for the purchase of automobiles. English manufacturers are also protesting against these restrictions, which, they say, hamper the automobile manufacturing industry at the present time, owing to the prejudice against automobiles, the systematic prosecutions and the heavy fines imposed for breaches of the 12-mile-an-hour limit, thus damaging an industry which is encouraged in almost every country, so that a source of employment for thousands of men is checked, and English automobilists are still ordering, to a great extent, machines from abroad.

THE MECHANICAL WORK OF THE TWELFTH CENSUS.

BY EDWARD W. BYRN.

Now that the Census Bureau has been made a permanent branch of the government, it attains the dignity and importance which its merits deserve. A popular impression prevailing among a large number of people is that the main part of the work of the Census is the taking of it, that is to say, the gathering of the data. That nothing could be more erroneous is evidenced by the fact that by legislative enactment a single month only was allowed for the taking of the Twelfth Census, while two years were given within which to tabulate the data. The data collected can have no meaning or value to the legislator and the student of sociology and political economy until classified into categories which form a basis for comparisons and conclusions. This is the real work of the Census Bureau, and it is of enormous proportions. The last decade of the nineteenth century added to the wealth of our country, according to Mulhall, twenty-five billion dollars, which is estimated to be more than the nation was able to save from the discovery by Columbus to the breaking out of the civil war. It also added immensely to the growth of our country in productive resources, in population and in problems sociological and economic. Upon undertaking their work therefore the officials of the Twelfth Census found confronting them such a demand for further data and more light affecting these interests, that new and extraordinary instrumentalities were invoked to shorten the labor, extend the tabulations, and increase the accuracy, speed, and effectiveness of the clerical force in separating, segregating, and classifying into categories the vast amount of data. The machine has been adapted to this work and made to take the place of the erring eye, the faulty memory, or the careless hand to such an extent that to-day the Census Office presents the appearance and busy hum of a vast machine shop rather than that of a great counting-house. Electricity has lent its expedition and subtle force to supplement human service, and the clerical work, largely emancipated from the errors of the personal equation, is brought under the control of physical laws. Facts and figures have thus within an incredibly short space of time been presented in such an array of categories and permutations as to give the student quick and convenient insight as to what this avalanche of figures means and what prophecy and suggestion they hold for the future. It is a splendid tribute to the executive ability of Director Merriam and to the experience and foresight of Chief Statisticians Powers, King, and Hunt, as well as evidence of the value of the invention as a factor in the world's work.



A FARM CARD, AS USED IN CENSUS CALCULATING MACHINE.

The Hollerith system of mechanical punching and tabulation had its inception in the preceding census, and its fundamental principles and instrumentalities were described and illustrated in the issue of this paper of August 30, 1890. The system, however, has been greatly improved and extended to meet the larger want of the present time. The two main features of the system are, first, a punched card, and, secondly, means for transferring its legend mechanically to registers which classify it into groups or categories and add the units thereof to form sum totals for the groups. The punched card varies somewhat in size and shape according as it is for population or agriculture. Generally speaking, it is from 5 to 7 inches long and 3 inches wide, and until its values are explained and understood it is a very insignificant and blind piece of paste-board. It stands between the enumerator's return sheet and the tabulating machine, and is the means by which the tabulating machine is made to *mechanically discriminate* in classifying the data borne by the card into groups, classes, or categories. The punchings in the card are not for the purpose of a public record, but are intermediary instrumentalities and the positions of the punched holes in the card mean everything to the tabulating machine. By the special location of a hole within the limits of certain boundary lines on the card it means one thing, and in another position it means another thing, and it is this position of a punched hole in a card that enables the tabulating machine to afterward transfer the value of that particular position of a hole on the card to a gang of counters and registers classifying the data into groups and adding the totals. It is done in this way: The card having been punched with holes to signify by their positions on the card the information contained on the written enumerator's schedule, the said card is put in a tabulating machine, where it acts as a stop diaphragm between a multiplicity of little spring-seated pins above the card and a corresponding series of mercury cups below the card. The pins are now, in a group, brought down, and those which are in line with holes in the card will descend through said holes and, by touching the mercury below, will close so many separate electric circuits. Those pins which do not find holes in the card below them do not pass to contact with the mercury and do not close their individual electric circuits. Each pin and its mercury cup are terminals of a separate electric circuit passing through an electro-magnet controlling a counter or register. The pins are carried in a frame known as a pin-box. It will thus be seen that the so-called pin-box is a sort of electric permutation circuit controller, and that the circuit closed through any one counter or register will be determined by one position of a hole in a card, and another circuit through another counter by another position of a hole. This gives the machine a mechanical selective action and constitutes its *mode of thinking*, as it were.

There are two kinds of punching machines. One is for population and the other for farms. In the farm punch the card is automatically moved through the machine under the punches, which correspond in number to the ten numerals, with one extra punch. In the population punch the card is held fixedly in a holder, and a swinging lever arm bears at the handle end a position-finding stylus, which has below it a large key-board of holes exactly corresponding in number, position, and grouping with the number, position, and grouping borne by the blank card. When the stylus is depressed into a certain hole in the key-board a punch, about mid-way of the lever, finds and punches a hole in the exact spot on the card corresponding to the hole on the key-board into which the stylus was depressed. Simpler and more recent is the farm card. In punching the spaces indicating dollars the units are, for economy sake, disregarded; thus 400 means $4,000; 150 means $1,500, and so on. The three columns to the left of the card simply divide the farms, their incomes and products, into ten groups, the first column giving ten sizes of farms, the second giving ten sources of income, and the third ten sizes of income, which are arbitrarily indicated by the figures and interpreted by an explanatory key.

The card having been punched, is then placed in a tabulating machine. The front view of a group of four tabulating sections shows the pin-box, and the handle for raising and lowering it being shown on the right. The rear view illustrates the quadrantal segments of electro-magnets arranged in rear and above the adding wheels. This view shows also the multiplicity of electric cables connected to the magnets and leading to the pin-box. It is not practicable within the limits of space available to describe in detail the tabulating and adding devices. It must suffice to say that a punched card is placed below the pin-box on the subjacent table surface bearing the mercury cups shown on the right of Fig. 5, and, the pin-box being brought down by the operator by means of the handle bar, the card automatically selects its counters or adding wheels as hereinbefore described. To explain how the machine adds, i. e., how a group of units is at one operation transferred to the adding wheel, reference is made to the rear view. For each adding device there is a quadrantal series of nine electro-magnets arranged in an arc about the adding wheels. A radial arm oscillates or swings about the center of the adding wheels, and in its sweep a pawl carried by it is made to turn the adding wheels any number of spaces according to the number to be added. This is accomplished by causing the turning pawl of the swing arm to act on the adding wheel sooner or later in the sweep of the arm. If it acts immediately on starting it turns the adding wheel nine spaces and adds 9. If it does not act until it has passed the fifth magnet it turns the wheel four spaces and adds 4. The timing of the action of the pawl on the adding wheel as the arm sweeps over the same is effected by the segmental series of electro-magnets as follows: Each magnet is connected to the electrodes of the pin-box, and the selection of a particular magnet in the curved series is controlled by the selective action of the punched card at the pin box, which is made to close a circuit through any one of the magnets of the curved segment. Such magnet when energized is made to release a trip pawl that is thrown into the path of the swinging arm and, striking an attachment thereon, causes the turning pawl of the swinging arm to engage an adding wheel and turn it a greater or less number of spaces according to the position of the magnet in the segmental series which has been energized.

A card to be tabulated on one of these machines is required to be placed *by the operator* beneath the pin-box, the pin-box depressed and the card then removed by hand. If the card is properly tabulated a little bell rings simultaneously with the depression of the pin-box. If a card has not been properly punched, the machine gives notice of the same so that the error may be corrected. When the card is removed, it is placed by the operator's hand in one of a series of compartments in a case for further classification, and to facilitate this work the pin-box is made, through electrical connections, to automatically open the proper door of the compartment into which the card is to be stored.

There are five different kinds of punched cards used in the work of the Census Office. In the agricultural division there is, in addition to the farm card herein illustrated, another card known as the crop card. In the population and vital statistics divisions there are three different cards, namely, the individual card, the family card, and the mortality card. In round numbers there have been employed in the whole work of the census something over 6,000,000 farm cards, 115,000,000 crop cards, 76,000,000 individual cards, 16,000,000 family cards, and 1,300,000 mortality cards. The average number of farm cards tabulated by the machine above described was, for the month of June, 1901, a little over 5,000 daily. This average has subsequently been raised to over 8,000 daily. The crop cards are handled more expeditiously, and 10,000 is the daily average. The division of agriculture employs twelve of the large farm-card machines and eighty-six of the smaller crop-card machines.

The latest development of the Hollerith System is the automatic machine, in which the work of separately placing each card beneath the pin-box, depressing the pin-box, and removing the card, is performed automatically by a machine instead of by hand. This automatic machine is operated by an electric motor supplied by current from the cable overhead. The cards are fed in a bunch to the top of the machine, the pin-box occupies a vertical instead of a horizontal plane, and the mercury cups are replaced by spring jacks. The machine itself successively feeds each card to the pin-box or circuit controller and tabulates its data automatically. If an improperly punched or distorted card happens to be in the lot it is automatically thrown out into a special receptacle for it, while the properly registered cards go to their own compartments. These machines have been used experimentally in the census work, and the following has been reported as the result of tests, viz., that in six and a half hours 87,000 cards were tabulated on 27 counters, forty to fifty minutes of which time was occupied in taking the readings from the counters. In the automatic machine there is one man to feed the cards in bulk and one man to take the readings from the counters, but each of these men may perform this service for a number of machines. It is estimated that the automatic machine is capable of doing at least six times the work of the hand machine.

For courtesies received in gathering the foregoing data thanks are due to Dr. LeGrand Powers, Chief of the Agricultural Division of the Census Office.

The Current Supplement.

Mr. Randolph I. Geare's article, "From Raft to Steamship," is continued in the current SUPPLEMENT, No. 1372. The third part of this interesting discussion is devoted to modern sailing ships, and is well illustrated by half-tones representing standard types. E. Price-Edwards concludes his article on "Sound Signals." "Some Notes on Steam Turbines" is the title of an illustrated paper by F. J. Warburton, in which a most important phase of modern steam engineering is treated. The account of the Paris Automobile Show, begun in last week's SUPPLEMENT, is concluded. A. D. Elbers contributes a most important article on "Tests and Constitution of Portland Cement." Coming as it does from a writer who has given no little thought to the subject, the article should be of wide interest. Among minor articles may be mentioned an account of the work at the World's Fair, city of St. Louis, "Texas Oil for Locomotive Fuel," "Lumière Process of Color Photography," and "Pressure of Luminous Rays."

A BOAT ON WHEELS.

BY JOHN L. VON BLON.

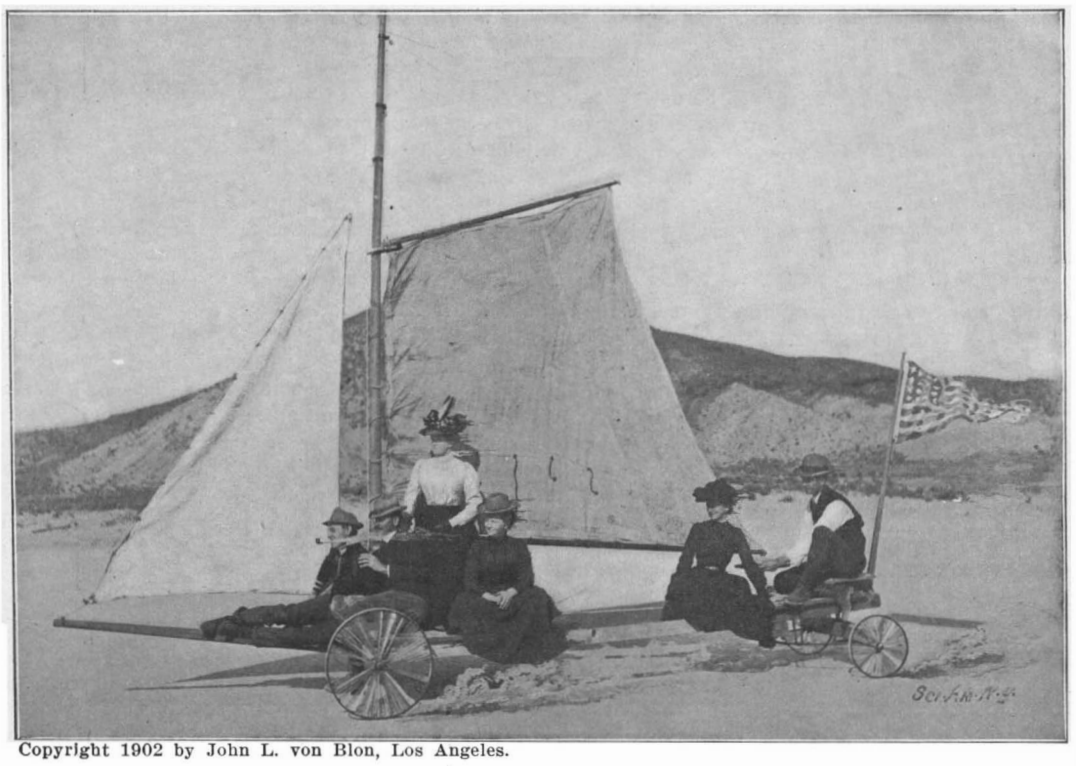
The queerest ship that ever sailed is a yacht on wheels, a graceful land-going clipper, that glides over the pathless stretches of sun-blistered plain, and carries her plucky navigators to and from their gold mine in the desert. Solitary gold hunters who have seen her white sails silhouetted against the bleak brown background in their aimless wanderings have brought to the outer world strange and ludicrous tales of a phantom ship that sped by them like a bird on the wing. The spectacle of a trim-built craft such as ordinarily belongs to the sea skimming over that barren expanse where not a drop of water ever falls might well alarm less superstitious persons.

This vehicle was built by Charles S. and Carl H. Hoyt, brothers, of Cleveland, O., eight months ago, and has been constantly in use since, running thousands of miles. Her owners have a gold mine in the buttes near the station of Rosamond, on the western border of the desert, and owing to lack of a suitable site they established their camp nine miles away. Between this place and the mine is a remarkable dry lake. Its surface is as hard as concrete, and swept as smooth as a tennis court by the sands forever driven over it by the fierce winds rushing down through the Tehachepi Pass. While trudging wearily over this level tract, before a gale that almost blew them off their feet, one of the Hoyts suggested that if they had a wagon with sails they might make the trip easier and quicker. This idea was followed out and with surprising success.

With only saw and ax and hammer and knives for tools, the young men began the work of construction. The material available consisted of the odds and ends to be found around a mining camp. The first requisite was a support for the machine, and for this the axle of an ordinary worn-out buggy was used, two iron wheels 30 inches in diameter, which had done service on a farming implement, being attached. Other parts were improvised with similar skill and ingenuity, and after a month of diligent application the workmen turned out a stanch "boat," 14 feet long, 8 feet across in front and tapering to the rear, with a mast 15 feet high, mainsail 10 feet on the boom and 10 feet on the mast, jib and jibboom to match. A steering contrivance like those on hook-and-ladder trucks was devised, and "Desert Queen" stood ready for her trial trip. The initial run was doomed to end in disaster. While tearing along before a strong wind at a terrific rate the machine got beyond control and a sudden gust brought her to grief with a crash. Bruised men, broken timbers and wrecked sails littered the ground. Neither of the Hoyts will ever forget the experience, for they will always bear the marks of the casualty as a reminder. Nothing daunted, they set to work rebuilding, and after many days repaired the damage and made necessary improvements, and now she carries her owners and their tools and supplies to and from the mine daily, and often on Sundays and holidays they take out excursion parties of half a dozen people, usually admiring visitors who have gone many miles to see the sight. Hundreds have been attracted to Rosamond from all directions for a look at "Desert Queen."

Speed is the astonishing quality of the craft, and almost beyond belief. Time and again she has sailed fifty miles an hour on the dry lake in favorable winds. On the open desert she has been speeded up considerably, and once is said to have made a straight run of forty miles in eighty minutes. She answers her helm perfectly and sails about as "close" to the wind as the ordinary water craft of her size.

A fast ride on "Desert Queen," amid surroundings more desolate than the lonely sea itself, is a thrilling and exciting experience. You go dodging between the dots of greasewood and cacti as you leave the camp for the solitude when the wind rises. Here and there grotesque yucca trees stand like sentinels, with gaunt



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YACHTING ON THE GREAT DESERT.

arms outstretched to reach you; horned toads scurry away over the hot sands, and lizards dart, looking like blue streaks, for the shelter, but not always quickly enough, for the "Queen's" wheels have crushed many before they could move; jackrabbits go skittering through the brush, and little ash-colored desert chipmunks scatter the sand about in their frenzied haste to get into their retreats; now and then a coyote, long and gray and lean—the picture of starved want—rises upon his scraggy hind legs and sniffs; occasionally you will run over a deadly "sidewinder" (rattlesnake) and hear the whirring of the rattles, or pass the bleaching bones of some poor creature that suffered the horrors of starvation and probably sucked the blood from its own parched tongue before the end came.

These are familiar scenes, and at first you notice them. Then the wind grows stronger and the pace madder. You tie a string to your hat and anchor it to your suspender; your handkerchief is whipped from your neck and goes sailing and writhing up and away —away out of sight almost before you realize that it is gone. The wind here is different from any that ever blew in any other part of the world. The "Queen" is fairly flying now and but a little sail is up. The air is filled with sand and pebbles as large as buckshot, and they pelt you hard; all around towering spirals of dust—small end of the spiral down—go springing across the plain, whirling up sand to feed the terrible storm that is sweeping from the Sierra Madre Mountains to Death Valley. Wilder becomes the speed, and you hang on frantically with both hands and find it hard to catch your breath. The man at the helm and the man hauling in canvas are too busy to see you gasp and shiver, but at last the sails are all lowered and the wonderful voyage is ended. But then it has not begun to blow yet on the Mojave Desert! Thirty minutes later you could not stand anywhere on the ground over which you have passed without a post to cling to!

SOME INTERESTING FEATURES OF THE KRUPP WORKS AT ESSEN.

BY HENRY L. GEISSEL.

One of the most attractive features at the Columbian Exposition in Chicago was that of the great Krupp works. Since that time this firm has made no similar exhibition, but it is just announced that a display, which will cost over a million dollars, is being arranged for the industrial exposition to be held in Düsseldorf. There is no industrial plant in the world the story of which is more interesting.

Within a few German miles of the Rhine, north of the Ruhr, in fertile, undulating, yet not attractive country, surrounded by the most important coal mines in Germany, lies the town of Essen. With the exception of a time-honored cathedral, Essen, despite its age, can boast of no historical relic of ancient days. The square before the town hall is embellished by a bronze monument from the master hand of the sculptor Schaper, representing not a king or hero, but a man clad in a simple citizen's coat, whose right hand rests on an anvil, and whose penetrating eyes are overhung by a thinker's brow. The granite pedestal bears in golden letters the words:

"Alfred Krupp."

The town of Essen has erected this life-like statue in grateful commemoration for generations now and to come of her most distinguished son. For this man, sprung from an old and honorable family in Essen, within the time of half a generation, raised the small unknown country town to its present importance and celebrity. He did not sit in the Council of Aldermen, but in the small steel foundry, inherited from his father, which employed hardly a dozen workmen. This steel foundry, however, rose to world-wide fame, and grew beyond all limits. At the time of Alfred Krupp's death, in 1887, the number of employés and workmen of his works was 25,000.

On April 1, 1901, the number of hands employed in all the Krupp works, including 3,823 engineers and office men, amounted to 46,077. A few figures, for which the writer is indebted to the courtesy of the administration of the Krupp works (who also, by the way, supplied the photographs reproduced with this article), show the immense extent of Krupp's establishments.

IN THE GUN SHOPS AT ESSEN.

During the year 1900 the works at Essen consumed 937,172 tons of coal, or an average of 3,123 tons per day, representing four railroad trains of 40 cars, each of a capacity of 20 tons. The other Krupp works consumed 655,125 tons, making a total of 1,592,296 tons, or 5,307 tons per day. The consumption of water at the Essen works, during the same year, amounted to 560,000,000 cubic feet, or equaled the annual water consumption of the city of Amsterdam. The gas consumption at the Essen works in 1900 was 665,000,000 cubic feet, as compared with 660,000,000 cubic feet consumed in 1900 by the city of Breslau. The number of gas-lights outside of the workshops was 2,658, and that within the shops 43,012. The gas works of the Krupp works is the sixth largest in the German Empire.

The electric plant of the steel works includes seven distributing stations, 128 miles of cable, 1,062 arc

lights, 9,097 incandescent lights, and 304 motors. The railroad system of the Essen works has a combined length of 68 miles, and the rolling stock includes 44 locomotives and 1,920 cars, while the telegraph system has a length of 52 miles and 37 stations, equipped with 58 Morse apparatus. Besides their own system, 18,037 telegrams were dispatched and received from the State Telegraph. The telephone service includes 39 stations, with 358 apparatus, the length of the wire lines being 278 miles. The average daily calls during 1900 were 1,100.

Krupp's fire brigade consists of 110 men, 86 electric signal stations, and 492 fire hydrants.

There were in operation at the Essen works during the year 1900: 1,600 various ovens and fires, 4,555 machines and machine tools, 132 steam hammers, 30 hydraulic presses, 316 stationary steam boilers, 497 steam engines, 558 cranes. In addition to the Essen works, the firm of Friedr. Krupp owns and operates the Annen Steel Works, formerly Asthöwer & Co., which Krupp acquired in 1866, and whose proprietor he made a member of his directorate. These works supply chiefly gun barrels, ship and railway materials, rudder frames, locomotive and car wheels, etc. About 1,000 hands find employment at Annen.

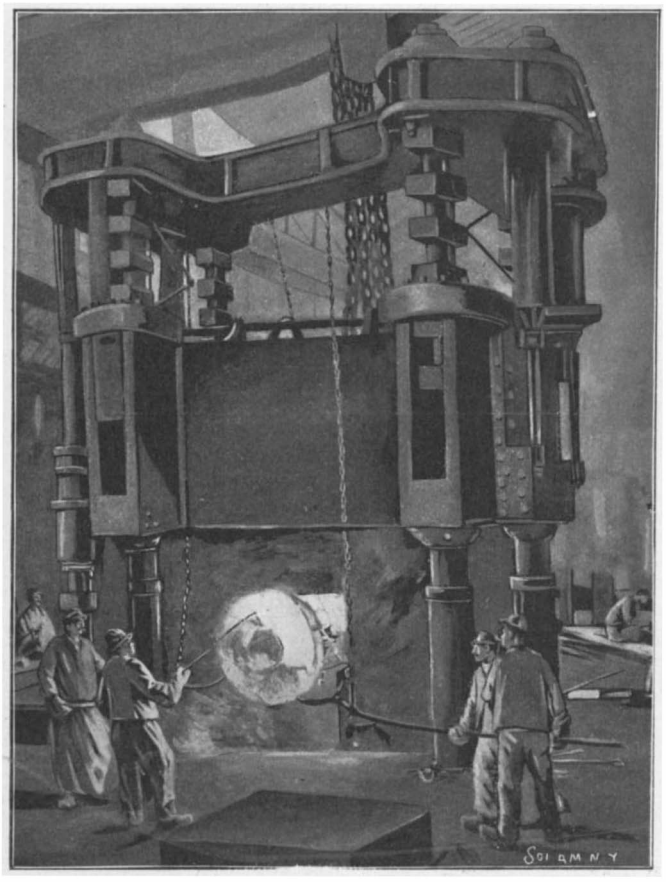
During the year 1893, the Gruson works of Buckau-Magdeburg became Krupp's property. These works make a specialty of the manufacture of iron-clad turrets, mining machinery, etc. Last year some 4,000 men were employed at the Buckau works.

The Germania Shipbuilding Yards, at Kiel, were added to the Krupp properties in 1896. The yards have turned out many battleships, cruisers, torpedo-boats, etc., and built also the Imperial yacht "Hohenzollern."

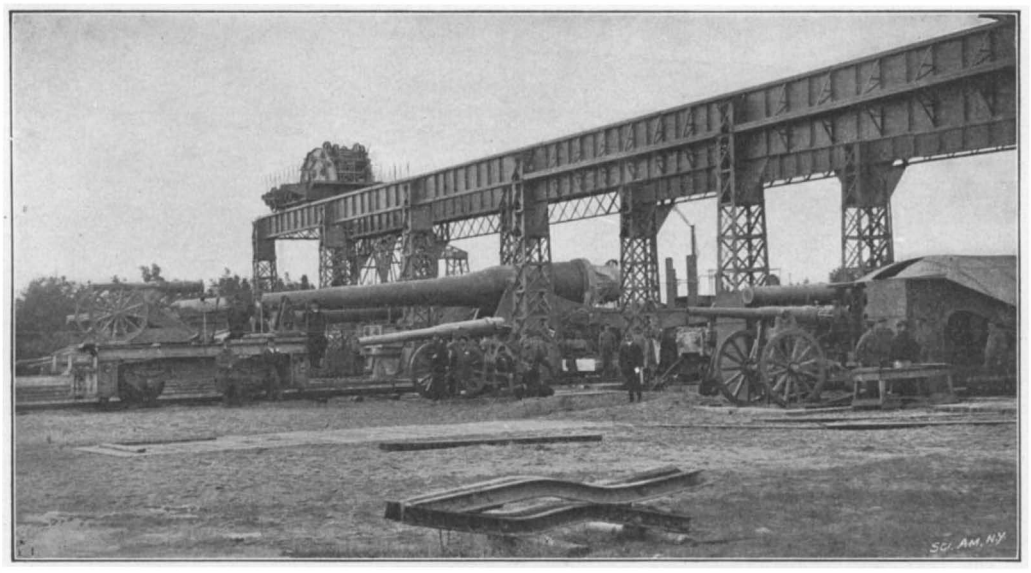
The firm furthermore owns and operates four metallurgical works with large blast furnaces at Duisburg, Neuwied, Engers, and Rheinhausen; steel works at Sayn, four coal mines, 500 iron ore mines in Germany, several mines in Spain, a proving ground at Meppen, three sea-going steamers, several clay, brick and stone yards, sawmills, etc.

One of the most interesting features is the Meppen proving ground, where heavy guns are tested. The middle yoke of the great traveling cranes for handling heavy guns is calculated to carry 200 tons, and the cranes, by their combined capacity, lift a 120-ton 17-inch gun from its 16-axle transportation car and place it on the carriage. The big gun and its four brothers are the largest in the world. Their armor-piercing projectile weighs 2,000 pounds; it is of the height of a tall man, and when propelled by a charge of 904 pounds of brown prismatic powder, it has an initial velocity of 1,980 foot-seconds, and an initial energy of 60,000 foot tons. The proving ground is also equipped with a complete meteorological observatory, in order to determine the resistance of the air, the velocity and force of the wind, the density of the air, temperature and barometric variations, etc. Some years ago, in the presence of the German Emperor and Herr Krupp, a 9.45-inch coast-defense gun, of 40 calibers, with a charge of 93 pounds of smokeless powder, fired a 174-pound shell a distance of 22,120 yards, or 12.6 miles. The curve of the trajectory would have passed over the Alps near Mont Blanc and its summit, which reaches an altitude of 21,594 feet, and would have risen above the top of Mont Blanc. Although this is the longest range ever reached in an experiment, it is by no means the limit which to-day can be obtained.

One of the cuts shows a view of the Essen shooting range. This place is situated right in the works. Properly speaking, it is not a shooting range, but rather a very extensive and costly testing place for the gun shops. Here, by a number of rounds, the resistance and working of the mechanisms of the completed guns and carriages are tested. This ground also serves for ascertaining whether the ballastic capacities of the guns are satisfactory. Another illustration shows one of the 5,000-ton hydraulic forging presses. Four cylindrical columns support a solid transom, from the lower side of which protrudes an iron cylinder 3.4 feet in diameter, which carries the hammer. A crane brings from one of the open-hearth furnaces the mass of hot steel, which is put on the anvil, and the ram descends slowly and noiselessly upon the ingot, flattening it like a piece of butter. The hydraulic pressure used is 8,500 pounds per square inch, yielding a total pressure of 5,000,000 kilogrammes, or 5,000 tons. When this press makes only twelve strokes a minute, and by each of them compresses the ingot two inches, this would correspond to the work of 666 horses.



5000 TON HYDRAULIC PRESS.



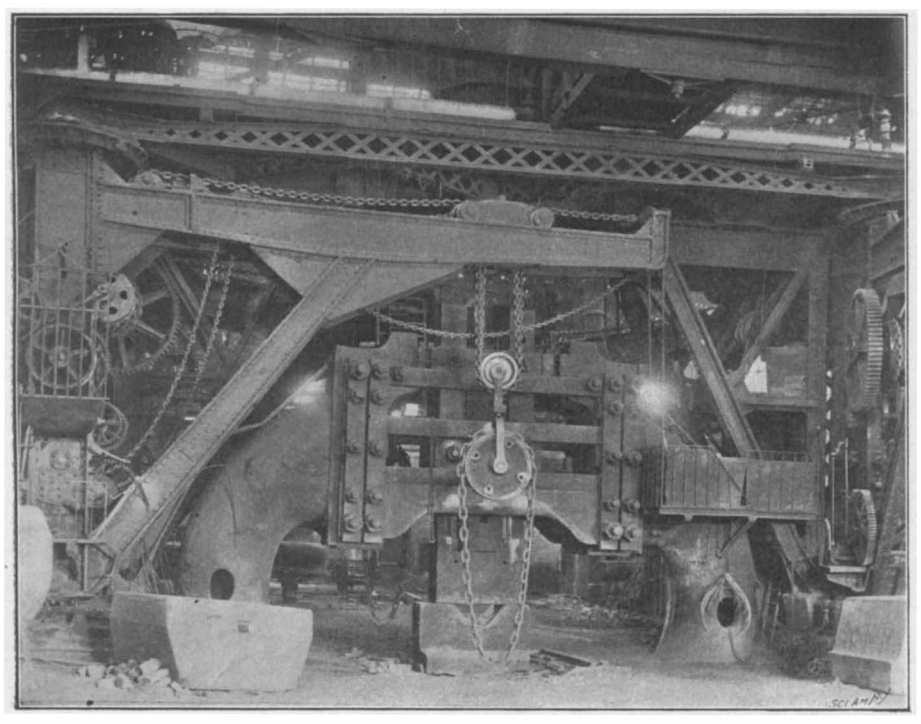
PROVING GROUNDS AT MEPPEN, SHOWING THE TRAVELING CRANE FOR SHIFTING HEAVY GUNS.

The Krupp works, however, are not only engaged in the manufacture of deadly weapons and war material, but many other articles are made. Steel rails, wire, iron and steel in bars and rods, structural iron, steel and iron wheels, armor-plates, sheet iron, steel forgings, steel castings, anchors, rudders, stems for vessels, steel shafts and cranks, springs, and many other things are turned out in immense quantities.

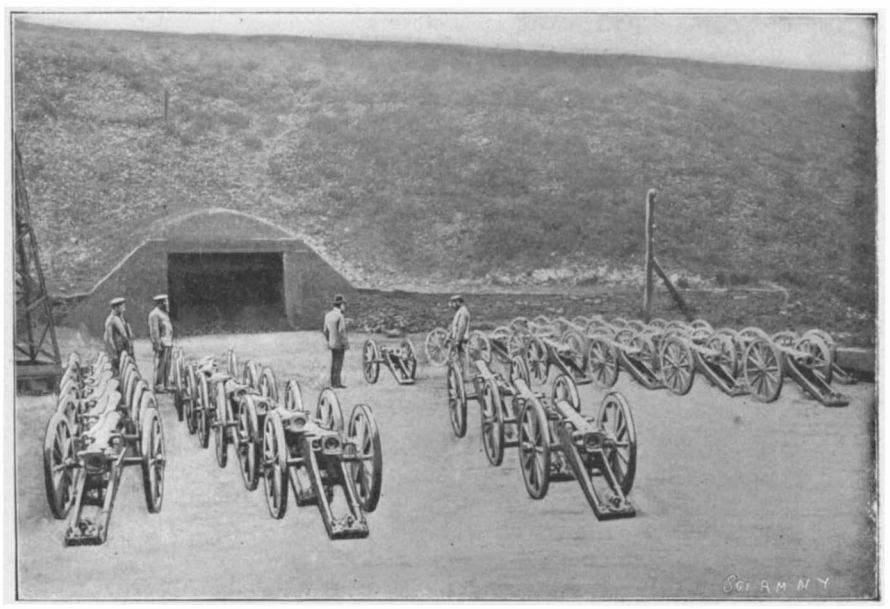
The present owner of the firm of Friedrich Krupp is Herr Friedrich Alfred Krupp, son of Alfred Krupp, and grandson of Friedrich Krupp. Last year the German Emperor, while visiting the Krupp family at their palatial country residence at Hügel, near Essen, bestowed upon Mr. Krupp, who is a close friend of His Majesty, the rank of an "Actual Privy Councilor of Commerce," which position, in Prussia, carries with it the title of "Excellency." At various times the Krupps have been offered a baronetcy, but they always politely declined, urging that they would rather rank among the "first citizens" than among the "last noblemen" of the empire.

Though Mr. Krupp dictates the policy of his immense enterprise —of which he is the sole owner— in person, yet the general administration rests with a "Directorium," composed of twelve members. The directorium is composed of financiers, engineers, military, naval, commercial and technical experts of highest standing. It is a kind of cabinet, over which the gun-king presides.

Some observations on the structure of *Nelumbo*, contributed by H. H. Lyon to the Minnesota Botanical Studies for 1901, throw considerable doubt on the correctness of the present position of the Nymphæaceæ in the natural system. According to him the fibro-vascular bundles are closed and are placed irregularly in the stem. The embryo at no time possesses two distinct cotyledons. The single cotyledon is at first quite undivided, but subsequently becomes deeply two-lobed, each lobe growing rapidly downward outside the endosperm. The structure of the ripe seeds conforms more closely to the monocotyledonous than to the dicotyledonous type. The development of the embryo closely resembles that of *Pistia*. On these grounds the author proposes that the order Nymphæaceæ be removed from the Dicotyledons and placed among Monocotyledons in series Helobiæ.



ONE OF THE KRUPP STEAM HAMMERS, SHOWING THE CRANE FOR HANDLING MATERIAL ON THE ANVIL.



A GROUP OF FIELD GUNS AT THE PROVING GROUNDS, MEPPEN.

AN INSECT GEOMETRICIAN.

BY HERMAN MUCKERMANN, S. J., SACRED HEART COLLEGE, PRAIRIE DU CHIEN, WIS.

Not less wonderful in its instinctive habits than ants and bees, though of a still more insignificant size and appearance, the *Rhynchites betulæ L.* is without doubt one of the most interesting species of the whole order of Coleoptera. In constructing the cradle for its young this tiny black snout-beetle has for ages been carrying out a problem which, at least in its entirety, was not known to man before the year 1673, when the great mathematical genius, Huygens, published his celebrated "Horologium Oscillatorium."

It may prove of interest to hear some particulars about this little architect, especially since, to our knowledge, its species does not occur among American Rhynchites. Therefore, in the following notes, I shall endeavor to give a brief account of this beetle and its problem, basing my remarks on the investigations and writings of Debay* and of Wasmann,† and upon observations which I myself made some years ago in Holland.

In early spring, as soon as the *Rh. betulæ*‡ has emerged from the ground, it climbs up a birch-tree, where, after mating, the female at once proceeds to construct from the pliant young birch leaves a little house for her offspring. Carefully examining the edge of a leaf, the beetle suddenly stops and begins to cut the outlines of what is to be the cradle for its little ones. It starts at the upper margin of one side of the leaf. Directing its head toward the upper part of the central rib, it cuts with its admirably adapted mandibles an S-shaped curve, whose terminal touches the leaf's central rib. Then after having made a slight incision into the main nerve of the leaf, in order to impair the flow of the sap, it cuts, across the other half of the leaf, a corresponding but more horizontal curve which terminates a little higher on the central rib. Then, after repassing the line of the entire cut to trim the edges and to cut through some nerves still connected, it once more stations itself at the starting-point of the whole operation. With the claws of its legs, whose femurs are powerful levers, it next grasps the edge of the leaf, and walking now downward, now to the middle, it rolls up in less than two minutes the one-half of the leaf into a sort of funnel, opening downward. After a short repast, which very prudently is taken from parts close to the main ribs, our little worker hastens to roll up the other side of the leaf around the funnel just formed, in which operation it uses its legs in a manner just the reverse of the former.

Now, after 30 minutes' work, the main preparations have been completed for depositing the eggs. The beetle crawls into the funnel's interior, cuts out three or four little pockets and introduces an egg into each. After this has been done, nothing remains but to close the precious chamber as firmly as possible. To accomplish this it walks first to the upper end of the funnel and pierces the different layers of the leaf in such a way as to make them adhere to each other. Then it returns to the lower end of the leaf, and grasping its apex, forms a second funnel, with its opening directed upward and fitting exactly into the larger one (Fig. 1).

In doing all this our little architect, otherwise of so timid a nature, exhibits such an interest and fervor that, as I myself more than once have observed, it does not desist from its ingenious work once begun, even though taken into the observer's hand.

Now in what does the real problem of the beetle consist and what has it to do with the conservation of its species?

Unrolling the leaf and spreading it on a plain surface (Fig. 2), we shall find that the exterior margin of the leaf and the S-curve cut by the beetle are in the same relation to each other as the two curves of higher mathematics, the involute and evolute, i. e., *v w*, *t u*, *r s*, *p q*, *l m* are almost perpendicular to the exterior margin *w*, *u*, *s*, *q*, *m*, and are equal to the corresponding curves *v y g*, *t y g*, *r y g*, *p y g*, *l y g*, respectively. In other words, our little mathematician cuts its S-curve so that the length of the cut made and the distance from the exterior margin always remain the same. This problem coincides with the task of higher mathematics, from a given involute to construct the corresponding evolute, and consequently involves a most complicated combination of differential calculus and geometry.

But to what kind of curve does the evolute of *Rh. betulæ* belong? As Prof. Heis first discovered, the evolute is in this case nothing else than an unfinished circle, which has its terminals in the joints, *g* and *y*. Besides, according to the same authority, the more horizontal curve of the second half of the leaf is to be considered as a very appropriate flattening of the first curve, which has a more perpendicular position. For, since the broader exterior windings, *A*, *B*, *C*, correspond to the smaller interior, *H*, *G*, *F*, without being shortened (i. e., *a b* and *c d* are equal to *l m* and *i k*, respectively), the second S-curve must necessarily lie in a more horizontal position.

This is one part of our little builder's problem. The other consists in the suitableness of the chosen curve to the formation of a funnel. Supposing that the beetle wished to construct from the birch leaf the largest and strongest funnel possible, and that, too, in the shortest time and with the expenditure of the least amount of its limited strength, it could really not choose a more suitable curve.

The funnel may be considered as a surface conically evolvable, which, when spread out upon a plane, coincides with it in all its points. Now such a surface can be rolled up in two ways, so that the lines of convolution meet either in one point or in a row of points, lying in a straight or curved line (Fig. 3). To have them meet in one point is, in our case, altogether out of question. For apart from the fact that the central rib would most probably tear in the course of the operation, it would exceed the strength of our little beetle to handle the whole surface, *o a*, at once. Therefore the second manner of convolution had to be chosen. Yet here again it would not do to have the upper margin in a straight line, for in rolling up the leaf the upper and lower openings would have to become either equal in their respective diameters or not. In the first case we would have no funnel, but only a useless cylinder; in the second the larger opening would be either above or below. If above, the funnel because reversed evidently would not serve its purpose; if below, the length of the side, *o a*, would either not correspond to that of the outer edge, *a g*, or at least the oblique position of the funnel would make it impossible to wind the other half of the leaf around it. The margin, therefore, must be a curved line. But this curved line again would be either convex or concave, or partly convex, partly concave. Of these possible cases, the first two would be impractical; for the merely convex margin has all the disadvantages of a straight one, and, besides, would make the poor beetle do superfluous work in rolling up a part of the leaf (*o b a c*), that is of no use in the formation of the funnel. A funnel with a merely concave margin would have too many windings closely packed at the top, and thus overtax the strength of the builder; and the funnel, which is subsequently to serve also as food for the larvæ, would have, perhaps, dwindled down too much in size.

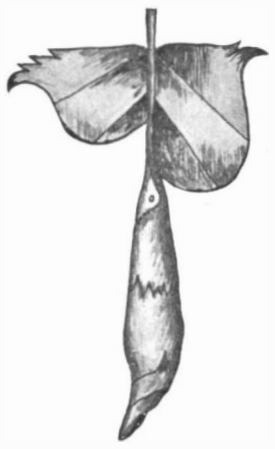


Fig. 1.—The Scientifically Constructed Nest of the Rhynchites Betulae. (After Wasmann.)

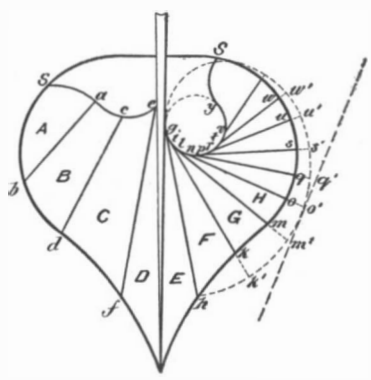


Fig. 2. (After Wasmann modified.)

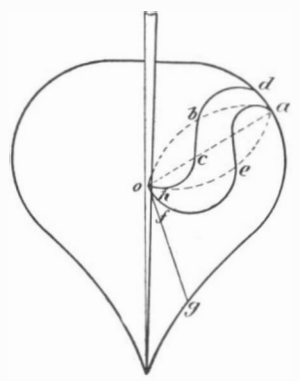


Fig. 3. (After Wasmann.)

The curve g w′ u′ s′ q′ o′ m′ k′ h′ represents the mathematical involute belonging to the evolute g i l n p r t v y.

Therefore, there only remains the concavo-convex line of section, in which again either the convex or the concave part might be longer. And here, as Wasmann justly remarks, "the technical ingenuity of our architect shows itself in its brightest light." For what would be the result if the convex part were longer? We need but to cut such a funnel from paper and see. First of all, it is not pointed enough. Besides, the part, *h b*, is not in the spiral of the point, as it should be, but along the vertical axis, and thereby the curve, *o c b d*, will no longer have the required length. And the part, *c a b d*, would most unsuitably protrude above the funnel's apex. At any rate, the funnel would be lacking in firmness and could not be closed so tightly as it should be.

But if, as is actually the fact, our architect chooses to make the concave part of the margin longer in the above mentioned proportion to the leaf's outer margin, then all requirements are most admirably met, and not a trace of the disadvantages of the former methods can be discovered. Without wishing to maintain that no other curve might possibly bring about the same result, there is certainly none so simple and yet so wonderfully appropriate.

To understand this still more clearly, we may finally direct our attention for a moment to the purpose which the funnel has. What is the real destiny of this artistic house? To insure the preservation of the species, *Rhynchites betulæ*, it is absolutely necessary that in its larval stage the young progeny should be guarded against all harmful influences resulting from atmospheric changes. Now it has been experimentally proved that every larva, in spite of abundant food, simply dries up when taken out of the tightly-rolled and well-sealed funnel. Moreover, on account of the constitution of its stomach, the larva can feed only on dry leaves, supplied by its habitation. And for making the birch leaf dry in due time, the mother beetle wisely provided by not forgetting to make the incision in the leaf's central rib. Finally, because the number of its progeny is so exceedingly small, it had to guard them well against all insectivorous animals. But who can suggest a hiding-place better adapted to its purposes than a dry, meaningless leaf, rolled up and closed with so great care?

Thus, whether technically or economically considered, the house of *Rh. betulæ*, constructed under normal conditions, is a real masterpiece and in every respect most perfect. Full of admiration, therefore, we look upon this little genius which, having scarcely escaped from its swaddling clothes, and without any education or experience whatsoever, performs a twofold mathematical and practical problem with the greatest skill and facility. Certainly to explain psychologically such a phenomenon, no automatic machine, as Cartesius believed, will suffice. For it is evident that *Rh. betulæ* is all the time guided by its senses. Neither can there be any question of an intelligence (*sensu proprio*) abiding in the beetle itself. For, first, such an intelligence would by far exceed that of man, and, secondly, it leaves unexplained the great stupidity which the beetle shows when the exterior circumstances are in any way disturbed by man or nature. The sole explanation best adapted to avoid all contradictions and to solve sufficiently all parts of this psychological problem seems to us to be given by instinct, as defined by Wasmann,* "the sum of the specific faculties of the sensitive cognition and appetency, essentially connected with the nervous system and transmitted by the same."

* Dr. Debay, Beitraege zur Entwicklungsgeschichte der Ruesselkaefer aus der Familie der Attelabiden, Bonn 1846.

† Erich Wasmann, S. J. Der Trichterwickler, Muenster 1884.

‡ From betula, birch-tree.

* Wasmann, S. J. Die psychischen Faehigkeiten der Ameisen. Zoologica. Heft 26, Stuttgart 1899, p. 81.

The Mushroom.

The London Lancet says: "The notion has long been held that the mushroom presented the composition of animal flesh, which led to its being called the 'vegetable beefsteak.' It appears, however, that this conclusion has been based on some analysis made many years ago, when analytical methods were not as exact as they are now and when the chemistry of food was not so well understood. In one regard, at any rate, the mushroom does resemble a beefsteak—in that it contains practically the same amount of water. But the dry, solid constituents of the mushroom differ very materially in kind from the solids of meat. The most important difference is due to the rich proportion of proteids—the so-called flesh-formers—in meat as compared with the feeble amount in the mushroom. This fact, as ascertained by recent analyses, hardly justifies the mushroom being regarded as a 'vegetable beefsteak.' It may be a blow to the vegetarian, but he would have to consume at least ten pounds of mushrooms in order to gain the equivalent of a little over one pound of prime beef. Indeed, in the light of modern inquiry there seems to be no reason for believing that mushrooms possess any greater food value than other ordinary fresh vegetable foods, and in many respects they compare unfavorably with them.

"Still, the fresh tender mushroom is undoubtedly easily digestible, and as it contains carbohydrates, in addition to some proteid, it is obvious that it is of some dietetic value. This value is not comparable with that possessed by essential foods, such as meat, milk and eggs. The mushroom, however, contains an unusual proportion of potassium salts. Few will deny that the mushroom is an excellent adjunct to many dishes; it has an appetizing flavor, and this quality alone makes it dietetically valuable."

International Exhibition of Motor Boats.

Count Talleyrand-Périgord informs us that an exposition and competition of motor-driven boats and motors for sailing boats will take place in June, 1902, near Berlin, on Lake Wannsee in the royal forest. Although the exhibition is especially intended for inventors and manufacturers of launches, it is expected that other trades will likewise give it the attention which it certainly deserves. Communications may be addressed to the Secretary, Universitaetsstrasse 1, Berlin, Germany.

Patent Department

THE DAVIS SHAFT COUPLING.

A coupling that will hold the abutting ends of two lines of shafting securely together in a straight line, without the use of keys or similar devices, is one of the latest mechanical appliances of the W. P. Davis Machine Company, Rochester, N. Y. The coupling is what is termed a "compression" coupling, or, in other words, one that exerts its force inwardly toward the shaft, instead of outwardly from the shaft.

The essential feature of the Davis coupling is to be found in an outer shell in the form of a belt-pulley, to which shell a hub is secured by arms tangentially disposed to the circumference of the hub. A glance at the accompanying illustration will show that this hub, so far from being of the ordinary construction, is split into three longitudinal segments, each of which is fastened to the outer shell by one of the arms mentioned. Within the hub, the ends of the shaft to be coupled are received. In order to lock the hub-segments and shaft ends rigidly together, clamps comprising each a sleeve and an integrally-formed flange are slipped over the tapered hub. As our illustration shows, the flanges of opposing clamps are drawn toward each other and locked together by bolts. It is evident that the tighter the nuts on the bolts are screwed up, the higher the clamp-sleeve will be seated on the tapered hub, the more closely will the hub-segments be contracted, and the more powerfully will the shaft ends be gripped. Mechanically considered, this coupling seems to be constructed on principles, the correctness of which can hardly be doubted. The fact that no keys are required, and that the few bolts employed are so completely housed that they cannot in any way catch the clothing of an attendant, are also points of interest and value. By the employment of reducing couplings it is possible to unite shafts of different diameters.

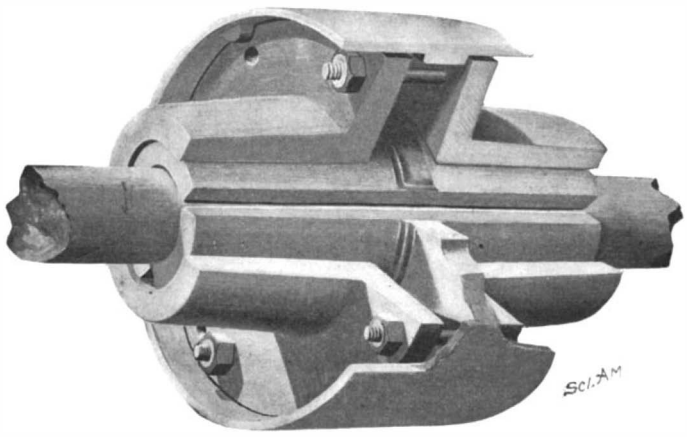
It will readily be seen that the coupling can be quickly placed on the shafting, and when drawn together it brings the shaft into perfect alinement.

To remove the coupling from the shaft the bolts are first taken out. Each bolt is then screwed into a tapped hole in the flange, and as the bolts are turned in, the point of each bolt comes in contact with the arm of the coupling. In this way the flanges are forced from the coupling.

THE HANSON-LEE TYPEWRITER.

It is now generally known that the first practical and successful typewriting machine of the "basket-pattern" was invented in Milwaukee, Wis., and that this machine, which was chiefly the invention of the late C. Latham Sholes, was taken to Ilion, N. Y., and put upon the market as the original "Remington," but it is not as well known that the latest achievement in this art, herein illustrated, is also a Milwaukee product. The Hanson-Lee machine, as it is called, is a distinct and radical departure from all its predecessors in the art of mechanical writing, its distinguishing characteristics being a vertically arranged horizontal revolving platen, in connection with a horizontally disposed key-board. By reason of this device this machine is peculiarly adapted for commercial work, involving long columns of figures, while at the same time it is equally as serviceable for correspondence, and the making of copies, as are the machines in ordinary use, employing horizontally arranged platens.

As shown in the accompanying illustration the Hanson-Lee machine is provided with a pair of vertical guide-posts, grooved for the reception of a vertically movable platen-supporting slide, the said platen being automatically revolved by the depression of the type-levers, and of a proper diameter to permit the sheet of paper to be wrapped around it, and held by a series of open annular spring bands. Besides the usual type-key, shift, and spacer-bar levers, there is a line key with connecting mechanism, so that the platen can be elevated the space of either a single or double line, as desired; and a margin-regulating mechanism and key, so that, at the end of a line (or sooner if desired) by touching this last-named key, the platen will whirl around and stop at the predetermined distance from the left edge of the sheet, for the beginning of the next line, the adjustment of the margin to any width desired being quickly made, and as quickly changed. The ribbon feeds automatically and is vertically disposed across the front of the platen, and as it is very narrow, only the line being typewritten is concealed thereby, all the preceding lines being always distinctly visible. The platen-supporting slide is movably supported on a central vertical shaft, and at any time can be depressed by hand thereon, if it is desirable to lower it, but the entire action of the machine is automatic, and by depressing an arm, and thereby forcing the platen-supporting slide from engagement with the dogs which ordinarily raise the platen, tooth



THE DAVIS COMPRESSION COUPLING.

by tooth, for each line, the slide carrying the platen will be instantly raised its full height, so as to be in position to remove the sheet of paper therefrom, or place a fresh sheet thereon, after which the platen can be quickly depressed to its initial position.

The actuating mechanism for vertically moving or horizontally revolving the platen comprises independent spring mechanism and suitable connections, there being two drums, with volute springs therein adapted to revolve said drums in opposite directions, the described line-key being connected with one of said drums for automatically raising the platen, without rotating the same, and the margin-regulating key being connected to the other drum for automatically revolving the platen, without varying its elevation, by the mere act of depression of one or the other of the said keys. Further, each time the last-named key is depressed to revolve the platen the spring within the drum connected thereto is thereby automatically wound up, so that there is no "running down" of the spring from constant use, and no winding by hand necessary.

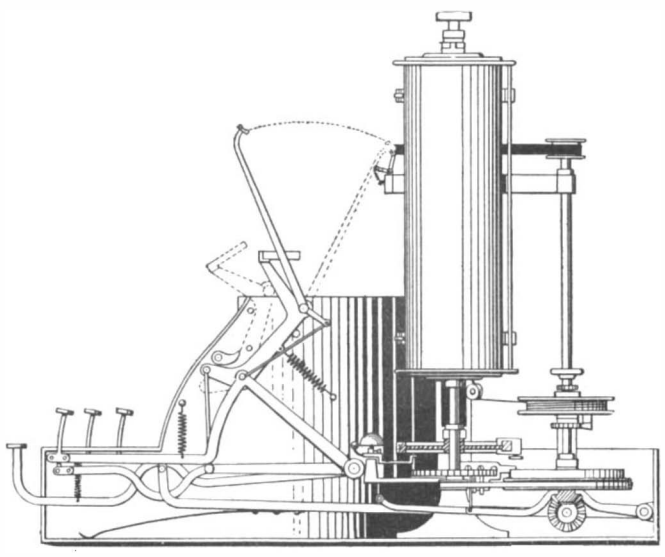
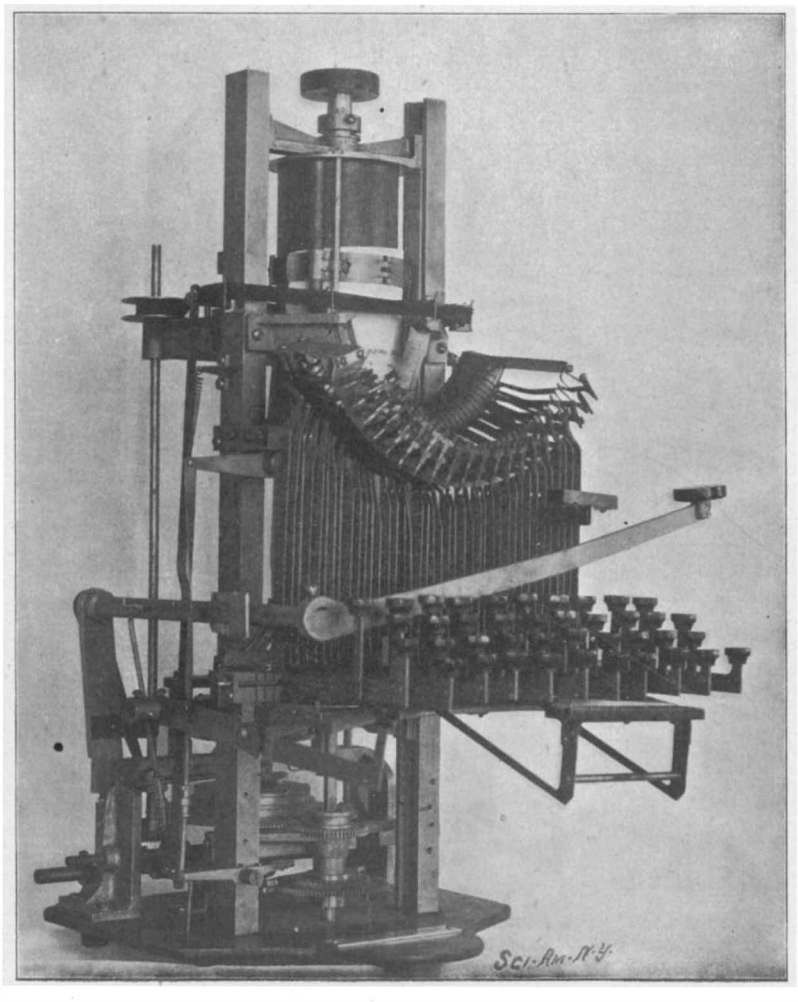


DIAGRAM SHOWING THE ACTION OF THE TYPEWRITER.



THE HANSON-LEE TYPEWRITER.

The characters are arranged, as is usual in shift machines, in pairs at the ends of the type-bars, which latter are supported in radially-disposed grooves in an arc-shaped guide, pivotally secured to the uprights of the machine, said type-bars being linked to the type-key levers, and when the shift-key is struck, the said guide, with the rear ends of the levers connected thereto, is thereby carried to the left, and changed in position so that the "upper case" characters will properly strike the common point of impact without any lateral change of position of the platen, the release of the shift-key causing the said guide to return to its normal position, this being accomplished without any frictional resistance or interference.

The original machine was invented by the late Walter H. Hanson, of Milwaukee, and patented some three years ago, since which time it has been greatly improved and simplified and is protected by a series of patents in the United States, Canada and the principal European countries. The present owner of the patents is one of the patentees, Rev. O. H. Lee, No. 462 Fourth Avenue, Milwaukee, Wis.

Inventions Awaiting the Touch of Genius.

For every ingenious young American, rich prizes are waiting, not only for great discoveries, but also for little things, simple improvements on the things we have. Whatever occupation he may choose, he will find that that calling is in need of men who can think of something new and better. For the men who have thought of new things, however simple, there have been in recent years in America, rich material rewards. Such a man was Hayward Augustus Harvey, who recently died a millionaire. His father was the village blacksmith in Jamestown, New York, early in the last century. Harvey saw how slow was the work of forging small things on an anvil, and sought to do it by labor-saving machinery. He became the pioneer in screw machinery and automatic pin machinery. He revolutionized screw-making. The gimlet-pointed screw was his. His last important discovery was the armor-making process which bears his name. He took out seventy-nine patents—not very many for a life of seventy years, but he did not rush to the Patent Office with every half-conceived idea. No fortune was ever more honestly earned or justly deserved than his. Like many other inventors, he showed his fellowmen how to live simply.

Concentrate your mind on the subject of needed inventions for five minutes, and you can think of a dozen things, any one of which would make its inventor rich beyond the dreams of avarice. To give a list of all the inventions that are needed in this year, 1902, would be beyond any man's power.—Franklin J. Forbes, in success.

A Heat-Detecting Machinery-Paint.

Machinery suffers, perhaps, as much from overheating as it does from general wear. In order to indicate when the moving parts have become excessively heated, a German inventor has devised a paint composed of an amalgam of the iodides of mercury and copper—a composition which, he claims, will turn color when heated bearings to which it is applied are red in color under normal conditions. But when a temperature of 140 deg. Fahr. is reached, the paint turns black.

Aluminium saw handles are being introduced which are said to be both lighter and stronger than those of wood. There are several shapes, but they are all made of thin sheet metal worked into the desired form and supplied with perforations for the purpose of enabling workmen to get a secure hold of the tool. One of the designs offered is adjustable so that the right hand side of the handle is flush with the saw, permitting the operator to work close to the floor or in other inconvenient places.

Brief Notes Concerning Patents.

A café is drawing trade in Chicago by advertising that every table is equipped with a telephone. This latest innovation is called a "snap jack." The telephones are movable, so that a diner may order one with his meals. Connection is made simply by dropping a dime in a slot in a box underneath the apparatus. A man may, therefore, eat, and talk with anyone miles away.

John J. Hoffman, formerly employed as foreman of the box department of the Duryea Starch Company, has brought suit against Walter E. Duryea for $50,000 damages. It is claimed that Hoffman designed a box which prevented the leakage of the starch dust therefrom, and he claims that Duryea induced him to assign the patent to him on the promise that he would form a company for its manufacture and sale, and this, it is alleged, he neglected to do.

The new lace machine invented by Herr August Matitsch, of Vienna, it is stated, will influence the lace manufacturing industry. The machine makes genuine lace of such a quality as to be absolutely indistinguishable from hand-made lace. The apparatus is based on the principle of the English twist lace machine, but is provided with a mechanism which makes it possible to move each carriage and each needle independently. The machine is a complete substitute for the pillow and other appliances for hand lace making.

The presentation to Congress of a memorial praying that the government bestow some recognition on Theodore R. Timby brings to light another inventor of the monitor turret. The memorial states that away back in 1841 Mr. Timby conceived the idea of a circular iron structure, rotatable on a vertical axis, which structure would contain guns that could be directed to any desired point on the horizon. At the request of John C. Calhoun, Mr. Timby is said to have made a model of his invention. In September, 1862, Mr. Timby took out patents on his revolving turret, and in the same year, through the influence of wealthy friends, he succeeded in building the "Monitor." It is claimed that John Ericsson worked out Mr. Timby's patented invention.

For transporting rails a truck has been designed which is somewhat similar to that ordinarily used by hook and ladder companies. It differs in the fact that it is collapsible, the connection between the two sets of wheels being made by a 6-inch pipe, in which slides a 4½-inch pipe. Thus the vehicle can be shortened to accommodate itself to the length of the rail, yet the pipes are held to the desired length by metal pins, placed at convenient points. Cranes attached to the forward and rear ends of the truck are connected with block and tackle, by which two men can readily raise and lower the heaviest rail carried. The steering apparatus consists of a wheel similar to those on a fire truck. In carrying short lengths of rail, a two-wheeled truck is supplied which is moved by hand power. This vehicle can be loaded on board the repair car, and will do the work of four to six men in lifting.

A new range finder has been invented by a London engineer which consists of two separate parts, a portable base and binocular field glass. The base is a tube, and has at each end of it a pair of reflecting surfaces placed at an angle of 45 deg. The binocular, which is of the prism type, has in its focal planes scales, indices, lines or wires, supplied with the necessary means of adjustment by which the angle between rays of light coming from a distant object and entering the two telescopes can be measured. An important part of the invention consists in constructing the binocular so as to vary the distance between the eyepieces without greatly varying that between the object glasses and without impairing the accuracy of measurement of the angle between rays. This effect is accomplished by mounting the two telescopes on a hinged joint, the hinges being in one plane, with the centers of the two object glasses for the mean distance between the eyes of observers.

Two eminent French scientists, M. Desgrez, a professor at the Faculty of Medicine, and M. Balthazard, a house surgeon in a hospital, have invented a new apparatus for purifying vitiated air, which will be of inestimable benefit in crowded offices, and other places where it is difficult to provide adequate ventilation. The appliance has been successfully tried before the Prefect of Police and the chief physicians of the Faculty of Medicine. The process is an application of the properties possessed by the compound sodium bi-oxide, which was discovered by an English chemist, Mr. Vernon Harcourt, in 1862, but has hitherto not been utilized. This compound, when brought into contact with water, decomposes immediately, one part of the oxygen being thrown off and oxide of sodium remaining. If therefore sodium bi-oxide be placed in water in an atmosphere which is being breathed, the supply of oxygen in the air will be constantly renewed, and at the same time the carbonic-acid gas present will, constantly and immediately on its production, be absorbed by the sodium mon-oxide, forming with it bi-carbonate of soda.

Legal Notes.

Construction of Patents.—The custom of the Federal Courts in construing patent claims as broadly as possible was again followed in the case of the Severy Process Company vs. Harper & Brothers (113 Fed. Rep. 581), which came up in the Circuit Court for the Southern District of New York. The patent, which it was alleged had been infringed, was for an improvement in platens for printing presses, and was granted to Melvin L. Severy, November 12, 1895. The subject of the invention was a bed or surface for the platen composed of a number of fixed, independently-yielding bristles or wires, by means of which a uniform impression was effected without the previous preparation of the platen, the impression cylinder, or type. The defendants' device is described in and protected by five Letters Patent, granted to Arthur S. Allen, all dated October 25, 1898. In the Allen patents the bed or blanket consists of fine wire coils interlocked and held in place between two sheets of rubber, which are not independently yielding.

Considered from a practical and commercial point of view, the court found that two points were incontestably established by the evidence: First, that the complainants' blanket was a "lamentable failure;" second, that the defendants' blanket was a "pre-eminent success." It was, therefore, held that when the question of infringement depends upon the construction of claims, the court, in the endeavor to ascertain what the inventor has given to the world, is justified in considering the invention as measured by the success achieved; and where the alleged infringer has taken the last step and has obtained the first commercially successful solution of the problem, care should be taken to protect him to the extent of his actual invention. Furthermore, the court held that the claims of a patent should not be so construed as to include devices which, though accomplishing the same function, do so by new combinations, operating upon principles so different as to entitle their originator to be considered as an independent inventor. There are many instances in the reported decisions of our Federal Courts where a monopoly has been sustained in favor of the last of a series of inventors, all of whom were groping to obtain a certain result, which only the last one of the number seemed able to secure. The case under question seems to be one of these.

A similar question came up in the case of Henry Huber Company vs. J. L. Mott Iron Works (113 Fed. Rep. 599). In that case the court held that a construction of the claims of a patent is not permissible which holds as an infringement a device which omits one of the elements of a combination, even if the remaining members accomplish a somewhat similar result. The Letters Patent in issue were those granted to Thomas C. Beaumont on February 18, 1894, for an improvement in hot-water bath fixtures. It was held that this patent was not entitled to a broad construction of its claims, or to a wide range of equivalents in view of the prior art, and could not be so construed as to include every device having such an arrangement of valves that steam cannot be turned on without also turning on a stream of water to be heated.

Transferability of a Trade-Mark.—So far as the transferability of a trade-mark is concerned, the Circuit Court of Appeals held, in the Severy case (*supra*) that a trade-mark is not of itself property that can be transferred, and the right to use it cannot be assigned except as incidental to the transfer of the business or property in connection with which it has been used. A transfer of the right to use it in connection with a different article or one of a different manufacture would result in deceiving the public as to the article or its origin, which it is the sole legitimate purpose of a trade-mark to prevent, and a transfer will not be protected for such use by a court of equity.

British vs. American Patent Practice.—A paper was recently read before the Royal United Service Institution by Benjamin H. Thwaite, in which British and American patent practice are contrasted.

In the preamble to his dissertation Mr. Thwaite pointed out that during the first half of the nineteenth century, and indeed up to the seventies, British engineering reigned supreme, that the railway, gas, and sewerage systems—the productions of British inventors of the early part of the Victorian era—were almost exclusively designed and constructed by British engineers and with British machinery. It was not until the close of the last century that English engineering suffered by American competition. Mr. Thwaite showed that the progress of Americans could be traced directly to the encouragement given to inventors by the United States government from the very inception of the Republic. How different was British policy, the author clearly pointed out. Whereas a Britisher might obtain a British patent, it was merely a registry of the date and the printed disclosure of the invention, and for which, during a term of fourteen years, he had to pay no less than £99 ($495); an American inventor was given, for the sum of $15, the benefit of an unprejudiced examination and investigation by patent examiners, each of whom may be considered a technical expert. Mr. Thwaite then dwelt upon the subsequent fees to be paid if the application finally passed the ordeal of this examination. The chances of an American patent's passing safely through a law contest are 74 to 100, according to Mr. Thwaite; but the chances of a British patent being found valid are only 58 to 100.

In order to demonstrate the deadly effect of the yearly taxation of the British patent system, Mr. Thwaite stated that of the 138,517 British patents applied for during the past five years, about 104,000 became void in the fifth or sixth year from the date of application, and the British government would have drawn in fees from those abandoned patents amounting to nearly £750,000.

When Substitution of Material Is Not Invention and When It Is.—In the Circuit Court for the Southern District of New York, Judge Coxe decided in the case of the Union Hardware Company vs. Selchow (112 Fed. Rep. 1006) that the substitution of one material for another in an existing structure, the effect of which is to render it lighter, cheaper and stronger, but which does not change its mode of operation, or increase its utility, does not rise to the plane of invention. The decision which was handed down repudiates the validity of the Hoerle patent 508,617, for an improvement in trucks for roller skates, which consists in making the truck frame from a single blank of sheet metal, instead of from cast-steel, as previously done.

In the same court it was held in the case of George Frost Company vs. Cohn (112 Fed. Rep. 1009) that the use of one material instead of another in the construction of a known article or machine amounts to invention, if the substitution accomplishes a new and useful result, an increase of efficiency and a saving in operation, and renders the article for the first time successful and satisfactory in operation. The subject matter which gave rise to the litigation was the Gorton patent 552,470, for a hose-supporter, the essential feature of which is the substitution, in the construction of the clasp, of a button made of rubber for the metal button previously used.

Trade Mark Blown in Glass.—Where distillers and selectors of gin have for many years put up and exported their gin in dark glass bottles of a distinctive size and shape, having their firm name, address, and their registered monogram trade mark blown in the glass, one who refills such bottles with an inferior quality of gin, which he sells without notice that such gin is not genuine, infringes on their rights, and should be restrained, though the refilled bottles are sold at a less price than the genuine, and do not have such distillers' monogram paper label and stamp on the cork.—Van Hoboken et al. vs. Mohns & Kaltenbach, 112 Fed. Rep. (U. S.) 528.

American Aniline Patent Sustained.—The United States Circuit Court of Appeals on February 5 handed down an opinion in the matter of Maurer vs. Dickerson and the Farbenfabriken, of Elberfeld, completely sustaining the validity of the American aniline patent. The patent in question has been attacked time and again. The foremost patent lawyers of the country have taken a part either side. Three times has the patent been before the Circuit Court of Appeals, and three times the Court declared it valid. The last decision will probably end a long legal battle in favor of the Farbenfabriken.

What Constitutes Infringement of Copyright.—An historical, biographical, and geographical dictionary, comprising a choice of articles treating in an original manner of subjects taken from books on which the copyright has expired, together with its nomenclature, may, when properly registered, be the subject of a copyright. It is of no importance that a work infringing a prior copyrighted work is an improvement on the former work and contains additional information, for such improvements do not remove the offense.—Beauchemin vs. Cadieux, Rep. Jud. Que. 10 B. R. (Can.) 106.

Fine for Counterfeiting Old Tapestries.—The Paris Court of Appeals has given its decision in the case of tapestry dealers who had falsified their wares so as to resemble antiquities. Charlaunes, of Paris, and Sauvageot, of Troyes, had sold these "doctored" aubussons to Mme. Lemaitre, of Epernay, and for this offense the Seine tribunal condemned them some days ago to six months' imprisonment, $200 fine and $1,400 damages. On appeal, the sentence has been confirmed, and the damages increased to $2,600.

RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

COTTON-CHOPPER.—A. D. EZZELL, Clinton, N. C. By a novel construction the machine first mashes down the portion of the row it is desired to chop and then cuts the mashed portions down. A harrow is provided at the rear of the chopper to harrow the cotton after it is chopped.

GANG-PLOW.—H. BRYAN, Modesto, Cal. The problem in gang plows has been to provide a draft attachment which could be securely locked in any adjustment and yet possess due strength and durability without too great weight of parts. Mr. Bryan's new plow is especially designed to meet this problem. The attachments are few in number and of inconsiderable weight, while the adjustment may be made with facility and the lock is perfectly secure.

GRAIN OR SEED SEPARATING DEVICE.—J. E. HILL and W. W. BROWER, Meservey, Iowa. The separating device is so constructed that a separating cylinder is employed in connection with spring risers secured to a vibrating or agitating grain table, the cylinder being of such character that it will not clog and will cause the straw to move freely to the rear end of the machine, while through the combined action of the cylinder and risers the grain is quickly and effectually shaken from the straw.

Miscellaneous Inventions.

GAS LIGHTER.—R. E. JÄHNIG, New York, N. Y. The gas lighter proper consists of a number of wires which are twisted together at one end and secured to a socket, the outer ends being laid in the notches of a comb-shaped cross member. At the inner end the wires carry a body of finely divided platinum. An apertured hood protects the wires. When the gas is turned on the finely divided platinum absorbs the gas so energetically as to become itself incandescent, thus igniting the gas.

APPARATUS FOR PRESERVING FRUITS OR VEGETABLES.—KATHRYN M. KEISER, Walshville, Ill. The improved apparatus provides for the reception of closed vessels adapted to contain fruits or vegetables. These vessels are exposed to the heating action of steam which is supplied from a steam tank in a manner to minimize loss or waste. The escaping steam is retained in a condenser and returns to the tank.

SETTING INSTRUMENT.—M. CHAMBERLAIN, Bartley, N. J. The object of the invention is to provide a means for setting the cutting edge of a square-nosed tool level in a planer or like machine, to insure accurate cutting of a key seat, and to allow of setting the instrument quickly for cutting the seat to any desired width.

MANUFACTURE OF HANDLED GLASSWARE.—H. BASTOW, Steubenville, Ohio. The invention provides means for casting handles directly upon the bowl or body of the glassware to insure homogeneity between the body and the handle. The body and handle are molded from the same mass, the handle being integral with the body at opposite points thereof and extending approximately parallel with the upper edge. The glassware is then reheated and the handle bent to extend transversely to the body in a vertical plane.

HOISTING GEAR.—F. V. NIELSEN, San Francisco, Cal. By using this gear the cargo can be readily lifted from the hatch and delivered clear of the ship's side. In many large vessels the distance from the mast to the center of the hatch is considerably less than the distance to the ship's side, so a guide for the lifting-rope, which will direct such rope to the center of the hatch, will not direct the rope to the side of the ship to deliver the cargo from the hatch. This invention provides guide devices to the lift-rope whereby the same may be adjusted relatively to the mast, so that it will operate centrally over the hatch and will also clear the ship's side.

PIPE-CLEANER.—J. L. STEITZ, Chicago, Ill. The cleaner is designed to thoroughly cleanse the pipe or draft-tube after a barrel or keg is empty, to keep the pipe as sweet as possible. A self-closing supply valve, which is connected with the supply of cleansing liquid under pressure, is arranged to receive the tapping-tube which, when forced downward, opens the valve and permits the cleansing liquid to flow through the tapping-tube and the parts connected therewith.

PLUMBING AND TANNING PROCESS.—S. SAXE, New York, N. Y. The process consists in subjecting the hides first to weak and then to progressively stronger solutions, containing both a commercial tanning extract and an extract of natural bark, and also containing a commercial lactic acid.

COMPOSITION OF MATTER.—F. JONES and C. L. PENNELL, Massillon, Ohio. These inventors have invented a composition which consisted preferably of 25 per cent of peat or vegetable soil, 50 per cent of clay, 20 per cent of straw, 1 per cent of tar, 1 per cent of soda ash, and 3 per cent of lime. This mixture is applied to a core bar and dried in an oven, when it may be used as a core for casting pipes and other tubular articles.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 2397.—For manufacturers of metal and leather card cases.

For mining engines. J. S. Mundy, Newark, N. J.

Inquiry No. 2398.—Wanted, addresses of firms manufacturing clothes pegs and pins.

Motor Vehicles. Duryea Power Co., Reading, Pa.

Inquiry No. 2399.—For parties to make a lead pencil attachment 1 inch long with rough outside surface.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 2400.—For manufacturers of porcelain tubes for gas engine spark plugs.

WATER WHEELS. Alcott & Co., Mt. Holly, N. J.

Inquiry No. 2401.—For dealers in electric and combination fixtures.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 2402.—For dealers in house wiring supplies.

WANTED.—Sole agency, Pacific coast, good article. Have capital. Box 856, Fresno, Cal.

Inquiry No. 2403.—For manufacturers of small motors (gasoline preferred) suitable for invalids' automobiles.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 2404.—For parties to manufacture a special envelope.

Rigs that Run. Hydrocarbon system. Write St. Louis Motor Carriage Co., St. Louis, Mo.

Inquiry No. 2405.—For dealers in envelope dies.

Patented articles, principally of cast iron, made and introduced. Atlantic Foundry, Phillipsburg, N. J.

Inquiry No. 2406.—For parties engaged in the rolling and polishing of copper.

Are you looking for anything in bent woodwork? Write Tucker Bicycle Woodwork Co., Urbana, Ohio.

Inquiry No. 2407.—For makers of castings for small steam engines of 2½ h. p.

We design and build special and automatic machinery for all purposes. The Amstutz-Osborn Company, Cleveland, Ohio.

Inquiry No. 2408.—For a small tongue or groove plane to cut a groove of ⅛ or less in a ¼-inch board.

For Machine Tools of every description and for Experimental Work call upon Garvin's, 149 Varick, cor. Spring Streets, N. Y.

Inquiry No. 2409.—For manufacturers of brick press or machines.

Progressive capitalist, interested in the solution of the aerial navigation problem, communicate with J. V. Janin, Seattle, Wash.

Inquiry No. 2410.—For dealers in electric elevators.

Factory room with power, steam, elevator, etc.; good light, also storage room. Chas. F. Kilburn, 84, 86, 88 Mechanic Street, Newark, N. J.

Inquiry No. 2411.—For a burner for brazing with crude oil and air pressure.

FOR SALE.—To party direct, for cash, patent 608,925 on folding umbrellas. No selling agencies need answer. M. R. Studams, Bridgeton, N. J.

Inquiry No. 2412.—For manufacturers of cheap motors.

FOR SALE.—Patent for "Vaporizer." This is O. K. and reasonable every way. G. F. Dyer, Manchester, Mass., Inventor and Patentee.

Inquiry No. 2413.—For dealers in electric novelties.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 2414.—For candy making machinery, such as lozenges, etc.

Designers and builders of automatic and special machines of all kinds. Inventions perfected. The W. A. Wilson Machine Company, Rochester, N. Y.

Inquiry No. 2415.—For the manufacturers of an attachment for spoons to avoid slipping into dishes, also for the makers of a spoon with a perforated bowl for mixing batter, etc.

ELECTRIC DRY BATTERY.—Manufacturers submit free samples with casting qualities. Quote prices for quantities. Darling Motor Company, Chicora, Pa.

Inquiry No. 2416.—For manufacturers of coffee roasters.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 2417.—For the address of Morton Evans & Co., makers of gasoline traction gear.

IDEAS DEVELOPED.—Designing, draughting machine work for inventors and others. Charles E. Hadley, 584 Hudson Street, New York.

Inquiry No. 2418.—For makers of gasoline fuel marine steam engines and boilers 1 to 4 h. p.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines. Correspondence Solicited. Address C. A. M. Box 773, New York.

Inquiry No. 2419.—For machinery for making a feed brick under pressure.

LAUNCH DESIGNS AND WORKING DRAWINGS FOR SALE.—Special designs made to order. Send stamp for booklet of designs of modern gasoline launches.

Harry J. Perkins, Naval Architect,
Grand Rapids, Mich.

Inquiry No. 2420.—For makers of hydraulic brick and clay working machinery.

WANTED.—A thoroughly reliable man to manage Steam Specialties Department in large wholesale house. Must be sober, competent and experienced. Give age, experience, references and salary expected. Address Box 482. New Orleans, La.

Inquiry No. 2421.—For makers of pocketbook rims and clasps.

Inquiry No. 2422.—For manufacturers of double automatic yard gates.

Inquiry No. 2423.—For a 20 to 25 h. p. traction engine for use on country roads for hauling freight.

Inquiry No. 2424.—For manufacturers of cheap clockwork to drive movable paper figures for advertising.

Inquiry No. 2425.—For parties to manufacture special machines.

Inquiry No. 2426.—For manufacturers of paper novelties, such as spoons with hollow handles, etc.

Inquiry No. 2427.—For dealers in second-hand belting.

Inquiry No. 2428.—For manufacturers of small refrigerating plants suitable for residences.

Inquiry No. 2429.—For a gas plant for from 25 to 50 Bunsen burners, also wire and piping.

Inquiry No. 2430.—For a dynamo for 100 to 150 incandescent lights; also an engine for pumping water and running dynamo.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending April 8, 1902,

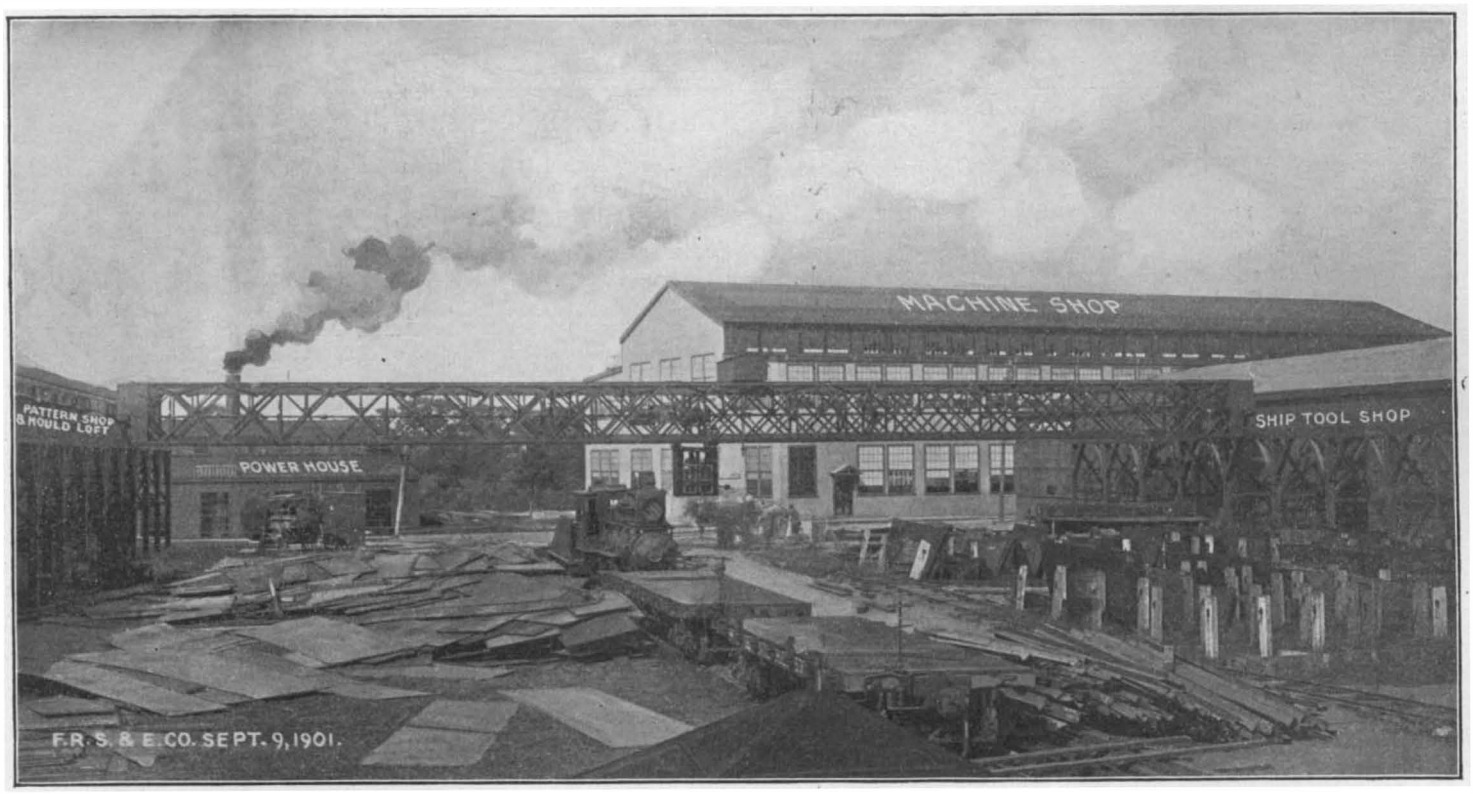
AND EACH BEARING THAT DATE.

(See note at end of list about copies of these patents.)

Abdominal supports, I. E. Palmer 697,164
Accumulators, charging, R. E. Ball 697,192
Accumulators, means for charging, R. E. Ball 697,193
Advertising device, Druar & Kregar 697,240
Advertising device, Church & Reynolds 697,397
Air-brake, J. E. Normand 697,003
Air compressor, Reeder & Freville 697,414
Air ship propeller, C. Groombridge 697,403
Amalgamating machine, G. C. Scott 697,176, 697,177
Ammunition, loading tray for transferring, J. Becker 697,126
Anchor, J. G. Watson 697,300
Anchor, ship's, F. W. Kenney 697,140
Animal trap, J. Chagnot 697,233
Antislipping device, D. M. Dearing 697,135
Armor plate, manufacture of, G. Charpy 696,941
Asphalt, preparing, A. Wolskel 697,307
Automatic brake, M. A. Beck 697,393
Automatic motor, C. J. Slafter 697,107
Axle, self-lubricating, M. Brune 697,068
Bank, savings, F. G. McPherson 697,268
Bars, etc., machine for forming, W. Baisch 696,923
Battery, W. C. Banks 696,924
Bed bottom, wire, J. Hoey 697,087
Bedstead, extension, W. E. Pack 697,102
Beet puller and topper, sugar, C. W. Bradley 696,934
Belt and shirt waist connector, J. N. Cunningham 697,329
Belt guide, C. McKeen et al 697,354
Bicycle and tricycle, G. A. H. Pietsch 697,104
Bicycle gear, E. M. Davis 697,073
Bicycle hubs, adjustable cone for, A. S. Reed 697,017
Blast furnace, G. P. Herrick 697,249
Boat, submarine, J. P. Holland 696,972
Boat transferring mechanism, L. Donne 697,202
Boats from ships, apparatus for launching life, C. F. Petersen 697,359
Boiler tube cleaner, C. T. Demarest 697,331
Bottle carrier, O. F. Clark 697,325
Bottle filling machine, Figueredo & Echemendia 696,955
Bottle filling machine, Strebel & Williams 697,221
Bottle, non-refillable, J. W. McCracken 697,352
Bottle stopper, A. Stern 697,036
Bottle washing or sterilizing machine, W. J. Cunningham 697,201
Box, L. J. Burdick 696,936
Box, E. Oldenbusch 697,216
Box fastener, Brenckle & Anger 697,195
Brake shoes, device for compensating for wear in hydraulic, A. Goldschmidt 697,140
Bran packer, J. S. Cameron 697,131
Brush, F. H. Tucker 697,295
Bubble blower, soap, C. E. Alhart 697,063
Buttons, etc., machine for making, W. B. Alden 697,189
Cage press, J. H. Hubbell 697,251
Calendar roll grinding machine, J. Linton 697,094
Cam, stamp mill, J. C. H. Vaught 697,119
Can. See Measuring can.
Can steaming machine, C. S. Bucklin 697,322
Can top and cap, J. B. Stewart 697,038
Cans, means for cooling milk, S. C. Sullivan 697,111
Canning apparatus, food, G. Lees 697,261
Candle holder, C. Bogendoerfer 697,127
Cane, flag, J. W. Freeborn 696,957
Cane, magazine torpedo, J. H. Fox 696,956
Car brake, F. F. Shaffer 697,283
Car coupling, T. J. Sammons 697,022
Car, drop door gondola, R. V. Sage 697,021
Car pusher, Boyer & Radford 697,194
Car roof, C. M. Jennings 696,976
Car step, folding, O. F. Thomas 697,293
Car street indicator, street, J. C. Wuerth 697,308
Car, tram, Stanley & Anger 697,288
Car ventilator, E. Anderson 697,125
Cars, etc. Folding step for, E. J. Hunt 697,208
Cars, system of operating fans by power for ventilating passenger, R. M. Dixon 696,947
Carousel, W. Johnson 697,254
Carriage, folding, C. E. Fanning 697,333
Cart shovel and scraper, A. Gehringer 697,243
Cash carrier, D. Lippy 697,347
Casting mold, E. D. Tucker 697,115
Centrifugal machine, A. Kaczorowski 697,255
Chain link, A. Palmros 697,165
Chain link, T. G. Aultman 697,190
Chair, A. M. Smitz 697,372
Change receiver, C. V. Smith 697,108
Chimney ventilator, C. D. Smith 697,180
Chopping knife, culinary, E. C. Phillips 697,167
Churn, F. W. Lippold 697,152
Churn, J. Groendyke 697,204
Churns, mechanism for operating vibrating, M. Cooper 696,944
Cinnamic ether of cinchona alkaloids, H. Thron 697,042
Circuit controller, E. M. Hewlett 697,144
Clock key holder, watchman's, A. Beyer 697,066
Clothes-line and peg holder or clamp. Combined safety, T. Grundy 697,404
Clutch, H. L. Henderson 697,206
Clutch, friction, A. E. Norris 697,271
Clutch operating device, G. L. Holmes 696,973
Coaster brake, vehicle, R. E. Hammer 697,337
Coffee, means for roasting, E. Boyes 697,129
Coin delivery device, J. M. Butcher 697,396
Coin freed apparatus for delivering sweets, etc., E. A. Jeffreys 697,148
Column step, T. J. Younglove 697,310
Communion service, individual, C. P. Harris 697,247
Conduits, means for inserting cords or the like into underground, L. J. Bergdoll 697,315
Contribution box, E. A. Burns 697,231
Coop, folding chicken, F. M. Steuterman 697,037
Copper nickel sulfid ores, treating, D. P. Shuler 697,370
Core bar, collapsible, J. D. Harless 697,083
Cornstalk cutter, N. C. Krauss 697,210
Crate, folding, A. J. Nolty 697,355
Creamer, centrifugal, Reck & Morsu 697,170
Cross tie, metallic, J. J. Wagoner 697,299
Cross tie, track fastening, and rail joint, combined, G. L. Kimberly 696,979
Crushing roll drive mechanism, A. M. Acklin 697,311
Cuff holder, P. Cumming 697,328
Cultivator, Willis & Porteous 697,059
Cultivator, beet, J. W. Shields 697,028
Cultivator fertilizer distributing attachment, S. Tannahill, Jr. 697,113
Cutter bar, D. E. White 697,050
Damper, R. G. Latham 697,258
Dandy roll cleaner, Weaver & Sanford 697,302
Dash pot, W. A. Heywood 697,145
Dental appliance, G. H. Claude 697,326
Desk, W. J. McDevitt 697,266
Diamond cross cutting machine, G. Armeny 697,230
Directory, cabinet, G. W. Maxwell 697,377
Directory, etc., mechanical, G. W. Maxwell 697,376
Directory, mechanical, G. W. Maxwell ..... 697,378 to 697,382
Dish making machine, C. Anderson 696,922
Door fastener, sliding, Kinter & Romig 696,980
Door hanger, J. J. Rexroth 697,218
Dough cutting machine scrapper, J. L. Causey 696,939
Drains and sewers, mode of and means for ventilating and flushing house or other, Shone & Ault 697,369
Dredging apparatus, Nolan & Mortenson 697,215
Drill. See Seed drill.
Drum or barrel head, J. L. Sheppard 697,027
Drying apparatus, L. Atwood 697,312
Edge setting machine, H. A. Oldershaw 697,356
Electric circuit protector, C. A. Rolfe 697,219
Electric circuit regulating device, G. P. McDonnell 697,158
Electric circuits, automatical safety switch for, O. L. Plumtree 697,273
Electric controller, F. E. Case 697,132
Electric controller, automatic, McGary & Mellinger 697,267
Electric distribution system, C. P. Steinmetz 697,035
Electric elevator, A. M. Modry 696,994
Electric machines, regulation of dynamo, T. W. Williams 697,057
Electric motor controller, W. B. Potter 697,012
Electric motor starting device, R. H. Read 697,016
Electric motors, controlling, M. W. Day 696,946
Electric switch, G. W. Hart 696,963
Electric switch, E. M. Hewlett 696,969
Electric switch, G. B. Painter 697,163
Electrical energy, means for transmitting, J. E. Woodbridge 697,123
Electrolytic apparatus, F. McDonald 697,157
Embroidering machine, D. Nadel 697,269
Embroidering machine pattern mechanism, D. Nadel 697,270
Engine, W. D. Linscott 697,346
Engine driving wheel, traction, K. R. Leehart 697,260
Engine speed regulator, explosive, J. S. Klein 697,409
Engines or motors, mechanism for utilizing the power of, H. W. Schlomann 697,175
Engraving machine, W. S. Eaton 696,952
Envelop, J. Lucas 696,985
Evener, doubletree, L. A. Tweedy 697,116
Eyelet, F. J. Leland 697,344
Farm gate, A. B. Clayton 696,943
Farm gate, G. R. Clarke 697,1 98
Feed and water device for chickens, G. C. Lathrop 697,343
Feeder for young calves or colts, R. A. Whitford 697,304
Felly, vehicle wheel, C. B. Van Horn 697,118
Fence, E. Lavely 697,259
Fence machine, Peak & Osborne 697,357
Fence post, C. W. Snook 697,031
Fencing, woven wire, J. M. Denning 697,074
File, account, L. J. Krohn 697,092
Filtering and lubricating apparatus, oil, J. B. Allfree 696,919
Firearm sight, C. J. Hamilton 696,962
Firearm single trigger mechanism, G. E. Witherell 697,061
Fire escape, H. Boettcher 696,931
Fire extinguishing apparatus, C. Nuhring 697,006
Fire kindler and method of making, A. F. Putnam 697,014
Firing valve for subsurface expulsion tubes, J. P. Holland 696,971
Flood gate, J. H. Ogle 697,159
Forge fire pot, blacksmith's, D. D. Reese 697,275
Fruit drier tray, J. H. Collins 697,237
Fruit grading machine, A. H. Pettit 697,360
Fuel block and briquet, F. Chailly 697,234
Furnace, J. MacCormack 696,987
Furnace grate bar, forced blast, Burger & Williams 696,937
Game apparatus, M. V. Hammack 697,406
Garment stretcher, E. Pickhardt 697,103
Garment supporter clasp, T. P. Taylor 697,222
Gas and oil burner, combination, G. A. Smith 697,030
Gas capsule, G. A. Logan 696,983
Gas generator, acetylene, E. J. Dolan 696,948
Gas generators, carbid feeding device for acetylene, W. E. Scofield 697,024
Gas heater, C. W. Claybourne 697,235
Gas lighting apparatus, C. Fader 697,080
Gas making apparatus, H. Spencer 697,373
Gas producer, E. J. Duff 697,399
Gear, transmitting, J. S. Copeland 697,200
Gearing, variable speed, L. E. Krotz 697,410
Glass, roller for rolling and ornamenting sheet or plate, L. Appert 697,229
Golf ball, E. Kempshall ..... 697,417 to 697,424
Golf balls, manufacture of, E. Kempshall 697,423, 697,425
Golf stick, F. L. Slazenger 697,179
Governor, steam engine, J. B. Allfree 696,918
Grain flow indicator, C. C. Neale 696,999
Grinding or polishing machine, A. Crocker 696,945
Gun sight, R. Chestnut 696,942
Handle for a number of implements, T. G. Moser 696,995
Handle locking device, swinging, E. Baumann 696,927
Hanging and fastening device, A. Schluter, Jr. 697,278
Harness hook, C. W. Hodges 696,970
Harrow tooth fastening, Willis & Porteous 697,058
Harvester bundle carrier, H. Green 697,142
Harvester fly wheel, Phelps & Morris 697,166
Harvester reel, C. W. Priestley 697,274
Hat and coat rack, J. L. Storm 697,289
Hat block, C. Muller 697,214
Hat box, folding, E. C. Beecher 696,928
Hats, drying, J. Marshall 696,989
Hay rake, sulky, A. R. Black 697,067
Hitching device, horse, A. W. Swanberg 697,039
Hog trough, F. B. Davis 697,259
Hoist, D. E. Rowland 697,276
Horseshoe, J. Riley 697,172
Horseshoe, nailless, J. W. Morse 697,155
Horse tail holder, H. E. Gavitt 697,242
Hose supporter, C. H. Wheeler 697,049
Human body, instrument for cooling or for warming internal portions of the, R. E. Smith 697,181
Hydrant, W. Henderson 697,084
Hydrocarbon burner, L. C. Graessle 696,961
Incandescent burner mantle, Prendergast & Slinack 697,361
Inhaler, pocket, H. J. Valentine 697,117
Insulator, W. H. Nichols 697,001
Insulator for high potential currents, R. Gaertner 696,958
Iron or steel, apparatus for making, E. Meininghaus 697,213
Jar attachment, G. E. Bateman 697,314
Jar closure, W. Sindorf 697,371
Jar stopper, L. Lohrmann 697,211
Jeweler's tool, R. H. Wade 697,120
Journal box, T. H. Symington 697,040
Junction box, M. F. Whiton 697,052
Junction box coupling, M. F. Whiton 697,051
Knitting machine, G. E. Ellis 697,078
Knob-attaching device, G. B. Pickop 697,168
Lace fastener, Andrews & Morrison 697,064
Ladder, extension, C. B. Totman 697,294
Lamp, electric arc, J. Eberhardt 697,077
Lamps, controlling arc, E. Oxley 697,007
Lamps, controlling electric, E. Oxley 697,161
Lantern, railway, Love & Ray 697,348
Last and union therefor, transversely divided boot or shoe, A. D. Tyler, Jr. 697,044
Latch, door, W. H. Wilsey 697,306
Lathe attachment, J. E. Mills 697,265
Lathe pan device, H. C. Osborn 697,413
Lawn rake, W. L. Frisbie 697,137
Leading spindle, O. Sundt 697,291
Leather shredding and grinding machine, R. J. Young 697,228
Life guard, T. E. C. Wilson 697,122
Life preserver, H. Prevost 697,362
Lighting, R. Thayer 697,292
Lighting, air pressure system of, J. E. Raff 697,015
Lock and latch, combined, L. H. Mullikin 697,156
Loom, filling replenishing, J. Northrop 697,004
Loom pile wire head, H. L. Matton 697,263
Loom shuttle, self threading, J. Northrop 697,005
Loom warp stop motion, H. J. Jarry 697,253
Match box, G. Greenland 697,245
Matrix for making gramophone, zonophone, or similar records, B. Kaplan 697,256
Mattress filler, G. W. Wareham 697,045
Mattress or cushion and heating attachment therefor, A. G. Schmied 697,279
Measuring and recording measurements of material, mechanism for, J. Hall 697,246
Measuring can, closed, C. H. Weber 697,047
Measuring instrument, I. B. Hagan 697,335
Meat hook, A. T. Clark 697,197
Mechanical movement, F. McKean 697,100
Mechanical movement, E. Horton 697,342
Metal pots, self feeding mechanism for, Place & Lewis 697,011
Metallic wheel, G. H. Everson 697,069
Miter box, R. H. Dorn 697,203
Molds. Forming sand, S. J. Adams 697,387, 697,388
Molding apparatus, C. M. Day 697,134
Molding apparatus, sand, S. J. Adams 697,385, 697,386
Mop wringer, F. W. Towne 697,223

(Continued on page 283)

A Stride Toward American Sea Power



THE PLATE YARD.—Showing the Crane which has a span of 150 feet and travels up and down the yard, a distance of 800 feet. In this Plate Yard there is stored at all times from ten to fifteen thousand tons of steel.

IF you would behold the American spirit in its purest, strongest and most buoyant phase—catch it on the wing, so to speak, learn the rate at which things under its inspiring influence can be made to happen, and see how truly robust and promising an infant is a shipbuilding plant, reared under its guidance, at the tender age of twenty-two months—go to Fore River.

At Fore River two things have been going on; the building of ships and the installing of a plant to build them. Logically the plant should come first, of course, but as a matter of fact the two enterprises have been carried on so side by side and intermingled that the ships, during the confusion, have managed somehow to come out ahead. This is most distinctly an American way of doing things—to start at nothing, keep moving at all hazard, and decide upon conveniences and methods afterward.

No even-minded European could ever proceed in such a manner; yet the scheme is a good one, economical and not without foresight.

This distinctly American spur-of-the-moment way of getting a great plant together is one of the principal reasons for our being so many years ahead of the rest of the mechanical world.

The other reason is to be found more graphically demonstrated by going into the shops themselves. It is that extraordinary willingness on our part to install new methods. The shops at Fore River, therefore, are as different in appearance from those installed ten years ago as door-knobs are from gooseberries. The principal contrast lies in the fact that the machines instead of being driven all from the same shaft by whirling pulleys and slatting, screeching belts, are each provided with a separate electric motor. Each lathe, each punch—even the grindstones—are run in perfect independence of the rest of the shop. Electricity is such extremely clean, noiseless stuff that it is hard to imagine one is in a machine shop at all. But though the advantages of it, in matters of light, cleanliness and quiet, are immediately apparent to the senses, for an appreciation of the financial advantage we must get out our slates. It often occurs in a ship-building works that one machine, either to save time or in order not to interrupt the boring of a cylinder, for instance, which, once begun, cannot be stopped, must be kept running all night long while the rest of the shop is idle. Now, horse-powers cost at the very least two cents an hour; and the main shafts and idle belts and pulleys of a large shop, without accomplishing anything, require about a hundred and fifty horse-power to keep them going. This at the end of a ten-hour day means $30, and at the end of the year $9,000, gone to waste in simply making a noise. To be able to run one machine at a time and to generate just what power is needed for it is obviously then a great advantage.

There are other ideas just as new and well adapted for time-saving; the idea of making the ship crane run up and down the dock, for example, instead of having to move the ships about under it; and the scheme of an auxiliary floating machine shop to enable the workmen to have power-tools close at hand, no matter where the vessel is on which they are at work.

We should be proud of the Lawrence and her twin sister, Macdonough, for they were built, not from Government designs, but from improvements on them made at Fore River. Every last detail of them was contrived especially for them without regard for standards, with the result that they have themselves become standards for speed and lightness at Washington.

However, it was not for this that I got you down to Fore River in the first place, nor to see the beginning of the two largest, fastest, most powerful battleships in the navy nor the only seven-masted schooner in the world nor yet on account of the big hammer; nor because in no other shipyard is there room and facility to build an even half-dozen 700-foot steamers side by side and have cranes and machinery enough to keep them all going. It is something broader and more magnificent than that and won't go down in figures.

The whole concern is so typical of the great movements on foot nowadays, so essentially twentieth century, so new; and I say, again, if you would see what we Americans, on the move, are really like, go to Fore River.

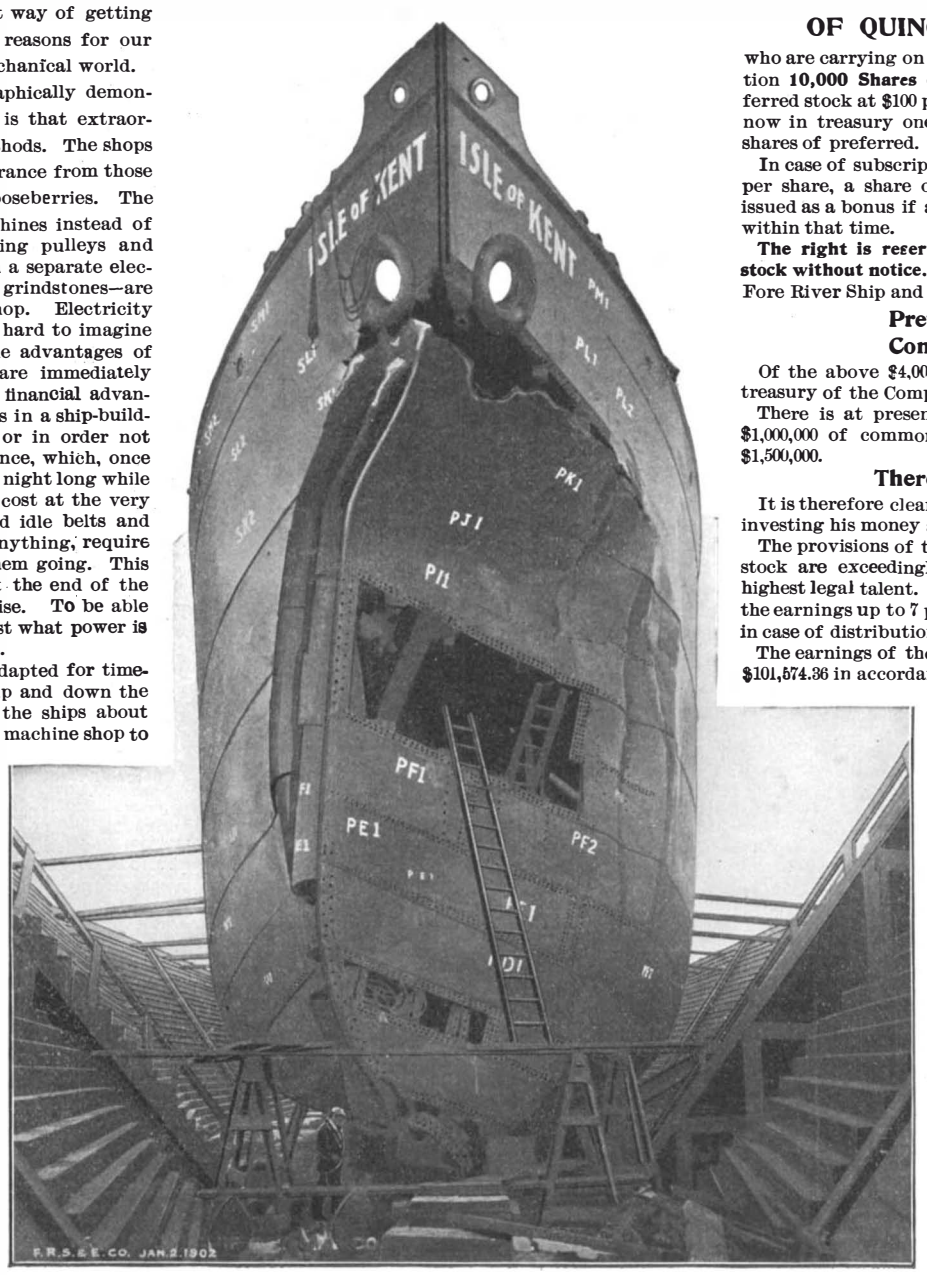
—Benj. Brooks, in *Boston Transcript.*

Work in Progress in Fore River Yard, April 1, 1902.

BATTLESHIP—New Jersey, 15,000 tons.
BATTLESHIP—Rhode Island, 15,000 tons.
CRUISER—Des Moines. To be launched May, 1902.
TORPEDO BOAT DESTROYER—Lawrence.
TORPEDO BOAT DESTROYER—Macdonough.
SEVEN-MASTED STEEL SCHOONER (11,000 tons displacement). The largest sailing vessel in the world. To be launched May, 1902.
FORGINGS for steamships now being built in other yards.
STEEL BRIDGE, 800 feet long, over Weymouth Fore River.
SEVENTY-FIVE SETS FORGINGS for rapid-fire guns.
MISCELLANEOUS STRUCTURAL WORK.

The above, with other work in hand, will bring the total amount of contracts up to $8,907,000.

In addition to the above contracts in hand, the Company has tenders under consideration for additional work aggregating several million dollars.



THE ISLE OF KENT.—This picture was taken in dry dock and shows how smashed up the bow of the ship really was. Fore River Ship and Engine Company repaired her in twenty-one days. Contract price $23,500.

The Fore River Ship and Engine Co.

OF QUINCY, MASS.

who are carrying on this mammoth business, offer for public subscription **10,000 Shares of Preferred Stock** on the following terms: Preferred stock at $100 per share, and of the 10,000 shares of common stock now in treasury one share will be given as a **bonus** with every two shares of preferred.

In case of subscription for one share only of preferred stock, at $100 per share, a share of common stock will be reserved for 90 days and issued as a bonus if a second share of preferred stock is subscribed for within that time.

The right is reserved to withdraw or reduce the bonus of common stock without notice.

Fore River Ship and Engine Co. is capitalized at $4,000,000.

Preferred Stock, 20,000 Shares
Common Stock, 20,000 Shares

Of the above $4,000,000 total stock authorized, there is now in the treasury of the Company $1,000,000 preferred and $1,000,000 common.

There is at present outstanding $1,000,000 of preferred stock and $1,000,000 of common stock issued against a plant which has cost $1,500,000.

There is no Bonded Indebtedness

It is therefore clear that the buyer of this preferred stock is not only investing his money at "bed rock," but even below it.

The provisions of the charter guarding the investor in this preferred stock are exceedingly strong, being drawn with great care by the highest legal talent. It has absolutely a first preference, not only on the earnings up to 7 per cent., but also upon the assets of the Company in case of distribution.

The earnings of the Company for five months to January 1, 1902, were $101,674.36 in accordance with the certificate of the Eastern Audit Co.

It should be remembered that these earnings were made *without* the advantage of having in the business the $1,000,000 which will result from the sale of the stock now offered.

The entire $2,000,000 preferred stock requires but $140,000 per annum for its 7 per cent. dividends. The Company earned at the rate of over $100,000 in excess of the amount required to pay the dividend on the entire $2,000,000 preferred stock, this while construction of the works was under way.

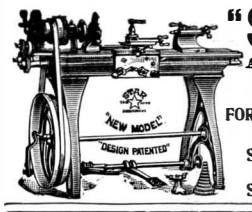
DIVIDENDS

By the terms of the Charter, semi-annual dividends on the preferred stock are payable on the second Mondays in January and July, out of the earnings of the Company.

In accordance with this provision, a dividend on the preferred stock of 3½ per cent. will be paid on July 14, 1902, out of accrued earnings.

Upon application to the Boston office of the Company, an illustrated description of the plant will be sent by mail, together with a complete financial prospectus and the certificate of the Eastern Audit Co.

Subscriptions and remittances may be made by check, registered letter or money order, payable either to Fore River Ship and Engine Co., 176 Federal Street, Boston, Mass., or to the Federal Trust Co., of Boston.



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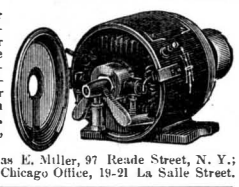

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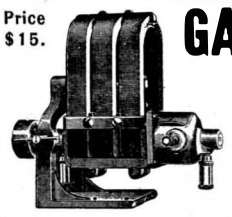

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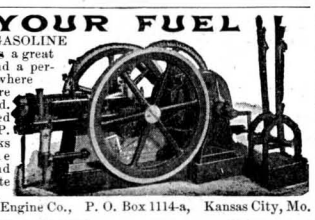

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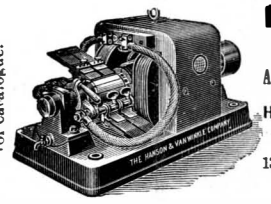

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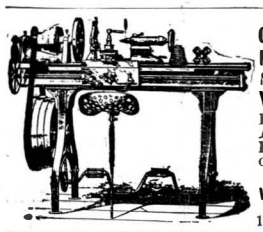

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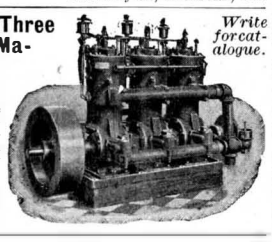

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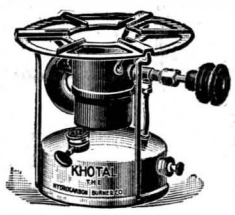

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(*Continued on page 284*)

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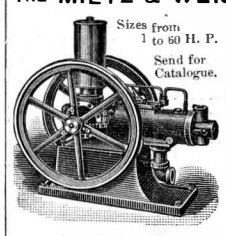

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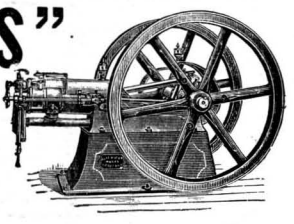

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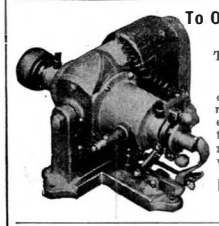

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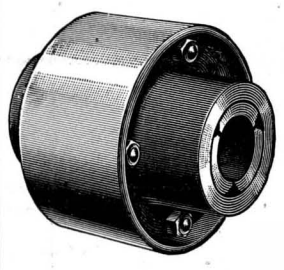

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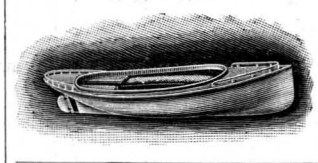

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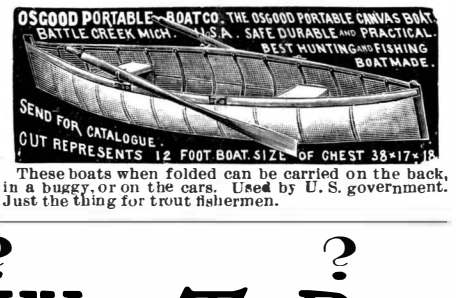
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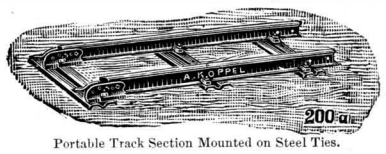

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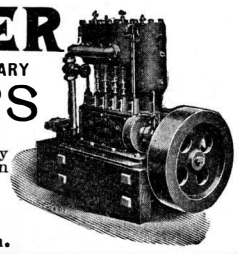

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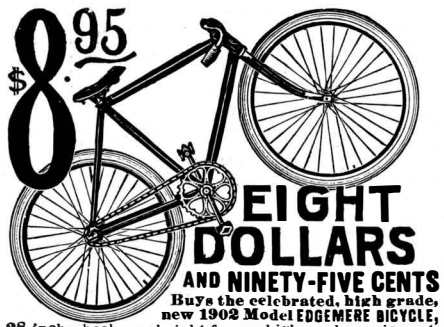

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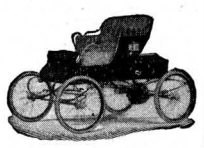

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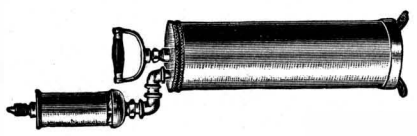

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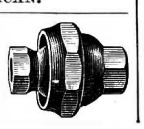

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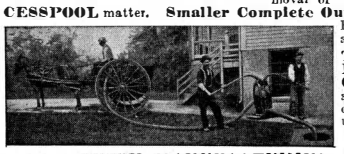

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(8584) G. C. T. asks how to solder a piece of carbon and a piece of brass together. I think the carbon has to be lined in some way. A. Copper the carbon with a battery, then attach the brass with soft solder.

(8585) J. F. C. asks: 1. What advantages has the double pole receiver over the single pole (as they are called) electrically? Why would not one coil, the same resistance of the two, placed on one pole of a permanent horseshoe magnet (traversed by an alternating current) affect the magnet flux as much as the two coils of half the resistance, one placed on each pole? A. A horseshoe magnet is always stronger than a bar magnet of the same number of turns of wire upon its poles, and so a double pole magnet in a telephone will act more powerfully than a single pole of a straight magnet. 2. Is pure soft iron free from resistance to magnetic flux? What is the resistance of the air to magnetic flux as compared to pure Norway iron? A. The number of lines of force which will pass through iron as compared with air under the same degree of magnetization varies with the degree of magnetization. It may be as much as 5,000 times as many, and it may be only a few times as many when saturation is nearly reached. See the table of permeability in electrical works such as Foster's "Pocket Book," price $5 by mail. 3. Which is correct to say, that a magnet attracts a piece of soft iron because it lowers the resistance of the magnetic flux, or that an opposite magnet is induced in its mass by induction? A. When a piece of iron approaches a magnet it both becomes a magnet and furnishes an easier path for the lines of force than the air. 4. Is the *greatest* force of attraction exerted in a magnet in attracting opposite poles of itself? A. We do not know whether a magnet works most in attracting its own poles or not. 5. What electrical disturbance is made by the action of the wind on telephone wires that a receiver takes it up? A. The noise to which you refer in a telephone is produced by vibrations caused by induction of adjacent wires and not by the friction of the wind. The wind produces no electrical disturbances.

(8586) M. W. and C. P. write: We would like to know, through the columns of your valuable paper, how a boiler of 15 horse power, that is only in use about three months during a year, should be left. Should it be filled with water or empty, and should the smokestack be protected. A. A boiler to be laid up for a season should be thoroughly cleaned on the inside, filled with water with steam on, so as to be full of hot water that has been boiled, up to the safety valve. The flues and fire surface of the boiler should then be cleaned; ashes and soot removed from every part where such lodge. Then close fire doors, ash pit, and put a cap on the smokestack. With this treatment laid-up boilers do not rust inside or outside. It is the moist air drawn through a laid-up boiler that does damage by rust.

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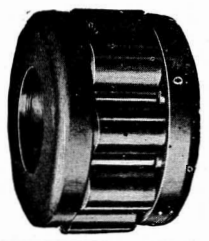

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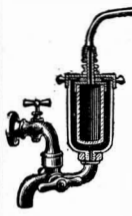

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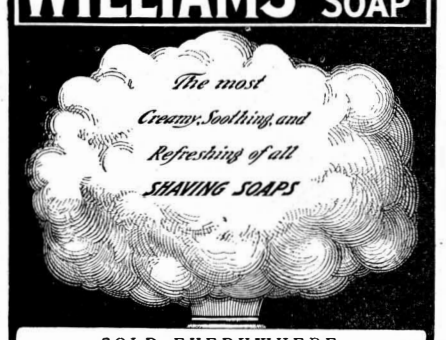

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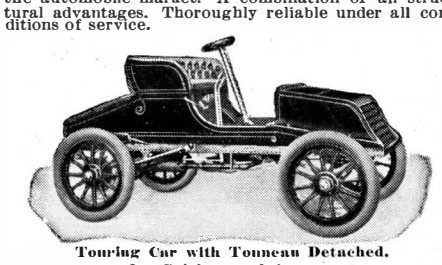

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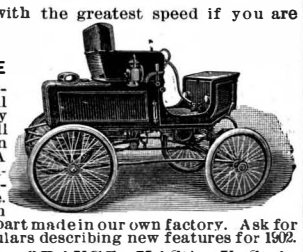

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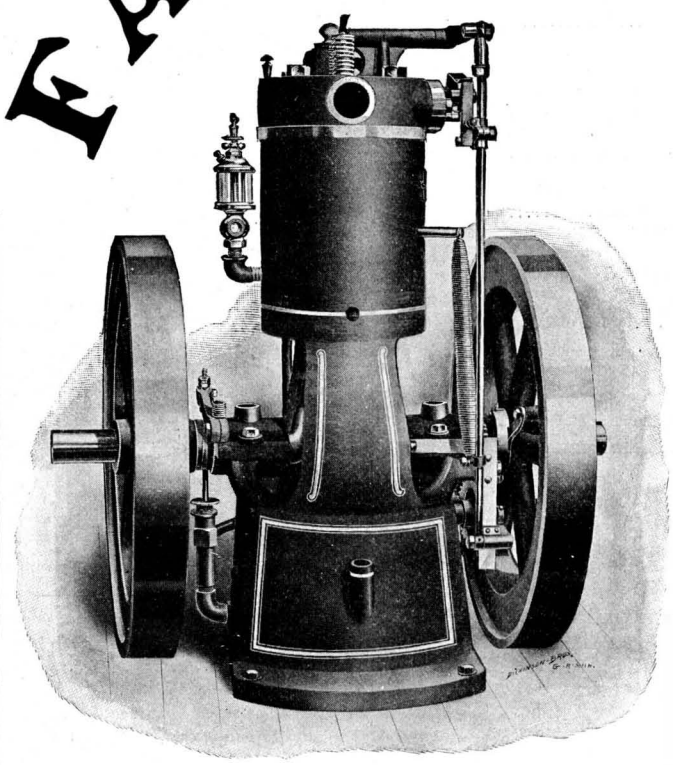

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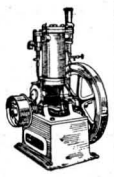

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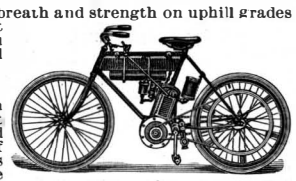

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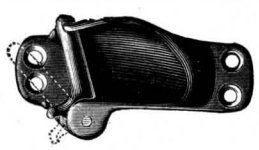

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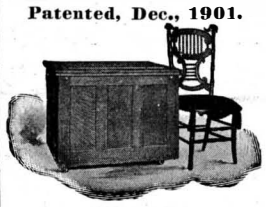

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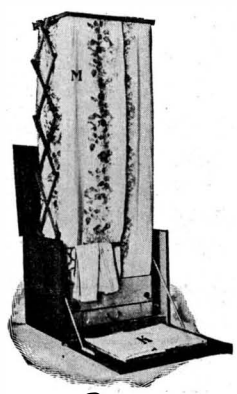

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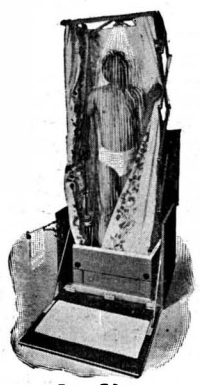

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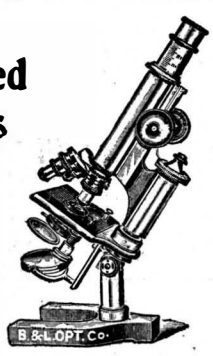

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